EXHIBIT H
Partially Redacted
Public Version

UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA
SAN JOSE DIVISION

CISCO SYSTEMS, INC., Plaintiff, v. ARISTA NETWORKS, INC., Defendant.	Case No. 5:14-cv-05344-BLF (PSG)

REBUTTAL EXPERT REPORT OF KEVIN ALMEROTH

SUBMITTED ON BEHALF OF CISCO SYSTEMS, INC.

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I.   INTRODUCTION

1.   I have been retained by counsel for Cisco Systems, Inc. ("Cisco") as an expert in this litigation to provide opinions regarding Cisco's copyrighted works and the infringement of certain Cisco copyrights by Arista Networks, Inc. ("Arista").

2.   I have also been asked to analyze and respond to the following expert reports submitted on June 3, 2016 on behalf of Arista:

- Expert Report of John R. Black Jr. ("Black")

- Expert Report and Disclosure of Cate M. Elsten ("Elsten")

- Opening Expert Report of Williams M. Seifert ("Seifert")

3.   My analysis, opinions, and reasoning are detailed below and in my opening report as well as the exhibits that accompanied my opening report, which provide additional analysis, opinion, reasoning, and evidence, and which are incorporated here by reference.

4.   I am paid my customary rate of $600 an hour for time spent on research, report preparation, deposition and/or trial. I am reimbursed for incurred expenses. I have not received, and do not expect to receive, any additional compensation for my work on this action, and payment of my fees is in no way contingent upon the outcome of this case, the outcome of my investigation, or the opinions that I provide.

5.   In this report I have provided the following main opinions/rebuttals:

a.   None of Arista's experts have shown that Cisco's copyrighted works or its IOS CLI is an industry standard and, in fact, the data provided by Dr. Black confirms my opinions.

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b.   I disagree with Arista's experts' opinions regarding the originality and creativity of Cisco's copyrighted works, and none of their opinions show that any of the copyrighted works are unoriginal or not creative.

c.   Arista's experts' opinions regarding the doctrines of *scenes a faire*, merger, and short phrases are inapplicable to the copyrighted works at issue in this case, and I therefore disagree that they have any impact on the copyrightability or originality of the copyrighted works.

d.   None of Arista's experts have come forward with evidence or opinion that would tend to show that any of the fair use factors—which I understand Arista bears the burden on—favor Arista.

e.   I disagree with Arista's experts' discussion and analysis of certain ancillary products not at issue in this case (e.g., network orchestration products and ConfD), and it is my opinion that those products have no bearing on whether Arista copied Cisco's copyrighted works in this case.

II.   BACKGROUND & QUALIFICATIONS

A.   Qualifications

6.   In forming my opinions, I am relying on my education and experience as described below.

7.   I summarize in this section my educational background, career history, publications, and other relevant qualifications.

8.   I am currently a Professor in the Department of Computer Science at the University of California, Santa Barbara (UCSB). I also hold an appointment and am a founding member of the Computer Engineering (CE) Program. I am a founding member of the Media

Arts and Technology (MAT) Program, and the Technology Management Program (TMP). I also served as the Associate Director of the Center for Information Technology and Society (CITS) from 1999 to 2012. I have been a faculty member at UCSB since July 1997.

9.   I hold three degrees from the Georgia Institute of Technology: (1) a Bachelor of Science degree in Information and Computer Science (with minors in Economics, Technical Communication, and American Literature) earned in June 1992; (2) a Master of Science degree in Computer Science (with specialization in Networking and Systems) earned in June 1994; and (3) a Doctor of Philosophy (Ph.D.) degree in Computer Science (Dissertation Title: Networking and System Support for the Efficient, Scalable Delivery of Services in Interactive Multimedia Systems, with a minor in Telecommunications Public Policy) earned in June 1997.

10.   One of the major themes of my research has been the delivery of multimedia content and data between computing devices and users. In my research, I have looked at large-scale content delivery systems and the use of servers located in a variety of geographic locations to provide scalable delivery to hundreds, even thousands, of users simultaneously. I have also looked at smaller-scale content delivery systems in which content, including interactive communication like voice and video data, is exchanged between computers and portable computing devices. As a broad theme, my work has examined how to exchange content more efficiently across computer networks, including the devices that switch and route data traffic. More specific topics include the scalable delivery of content to many users, mobile computing, satellite networking, delivering content to mobile devices, and network support for data delivery in wireless network.

11.   Beginning in 1992, when I started graduate school, the first focus of my research was on the provision of interactive functions (VCR-style functions like pause, rewind, and fast-

forward) for near video-on-demand systems in cable systems. In particular, my work explored how to aggregate requests for movies at a cable head-end, and then how to satisfy a multitude of requests using one audio/video stream broadcast to multiple receivers simultaneously. Continued evolution of this research has resulted in the development of new techniques to scalably deliver on-demand content including audio, video, web documents, and other types of data, through the Internet and over other types of networks, including cable systems, broadband telephone lines, and satellite links.

12.   An important component of my research from the very beginning has been investigating the challenges of communicating multimedia content between computers and across networks. Although the early Internet was designed mostly for text-based non-real time applications, the interest in sharing multimedia content quickly developed. Multimedia-based applications range from downloading content to a device to streaming multimedia content to be instantly used. One of the challenges is that multimedia content is typically larger than text-only content, but there are also opportunities to use different delivery techniques since multimedia content is more resilient to errors. I have worked on a variety of research problems and used a number of systems that were developed to deliver multimedia content to users.

13.   In 1994, I began to research issues associated with the development and deployment of a one-to-many communication facility (called "multicast") in the Internet (first deployed as the Multicast Backbone, a virtual overlay network supporting one-to-many communication). Some of my more recent research endeavors have looked at how to use the scalability offered by multicast to provide streaming media support for complex applications like distance learning, distributed collaboration, distributed games, and large-scale wireless communication. Multicast has also been used as the delivery mechanism in systems that perform

local filtering (*i.e.*, sending the same content to a large number of users and allowing them to filter locally content in which they are not interested). As part of this research, I looked at how to implement multicast functionality in Internet routers and switches and undertook an extensive analysis of how multicast was being used in the Internet by collecting and analyzing Internet router data.

14.   Starting in 1997, I worked on a project to integrate the streaming media capabilities of the Internet together with the interactivity of the web. I developed a project called the Interactive Multimedia Jukebox (IMJ). Users would visit a web page and select content to view. The content would then be scheduled on one of a number of channels, including delivery to students in Georgia Tech dorms via the campus cable plant. The content of each channel was delivered using multicast communication.

15.   In the IMJ, the number of channels varied depending on the capabilities of the server including the available bandwidth of its connection to the Internet. If one of the channels was idle, the requesting user would be able to watch their selection immediately. If all channels were streaming previously selected content, the user's selection would be queued on the channel with the shortest wait time. In the meantime, the user would see what content was currently playing on other channels, and because of the use of multicast, would be able to join one of the existing channels and watch the content at the point it was currently being transmitted.

16.   The IMJ service combined the interactivity of the web with the streaming capabilities of the Internet to create a jukebox-like service. It supported true Video-on-Demand when capacity allowed, but scaled to any number of users based on queuing requested programs. As part of the project, we obtained permission from Turner Broadcasting to transmit cartoons and other short subject content. We also attempted to connect the IMJ into the Georgia Tech

campus cable television network so that students in their dorms could use the web to request content and then view that content on one of the campus's public access channels.

17.   More recently, I have also studied issues concerning how users choose content, particularly when considering the price of that content. My research has examined how dynamic content pricing can be used to control system load. By raising prices when systems start to become overloaded (i.e., when all available resources are fully utilized) and reducing prices when system capacity is readily available, users' capacity to pay as well as their willingness can be used as factors in stabilizing the response time of a system. This capability is particularly useful in systems where content is downloaded or streamed to users on-demand.

18.   As a parallel research theme, starting in 1997, I began researching issues related to wireless devices. In particular, I was interested in showing how to provide greater communication capability to "lightweight devices," *i.e.*, small form-factor, resource-constrained (*e.g.*, CPU, memory, networking, and power) devices.

19.   Starting in 1998, I published several papers on my work to develop a flexible, lightweight, battery-aware network protocol stack. The lightweight protocols we envisioned were similar in nature to protocols like Universal Plug and Play (UPnP) and Digital Living Network Alliance (DLNA).

20.   From this initial work, I have made wireless networking—including ad hoc and mesh networks and wireless devices—one of the major themes of my research. One topic includes developing applications for mobile devices, for example, virally exchanging and tracking "coupons" through "opportunistic contact" (i.e., communication with other devices coming into communication range with a user). Other topics include building network communication among a set of mobile devices unaided by any other kind of network

infrastructure. Yet another theme is monitoring wireless networks, in particular different variants of IEEE 802.11 compliant networks, to (1) understand the operation of the various protocols used in real-world deployments, (2) use these measurements to characterize use of the networks and identify protocol limitations and weaknesses, and (3) propose and evaluate solutions to these problems.

21.   As an important component of my research program, I have been involved in the development of academic research into available technology in the market place. One aspect of this work is my involvement in the Internet Engineering Task Force (IETF), including many content delivery-related working groups like the Audio Video Transport (AVT) group, the MBone Deployment (MBONED) group, Source Specific Multicast (SSM) group, the Inter-Domain Multicast Routing (IDMR) group, the Reliable Multicast Transport (RMT) group, the Protocol Independent Multicast (PIM) group, etc. I have also served as a member of the Multicast Directorate (MADDOGS), which oversaw the standardization of all things related to multicast in the IEFT. Finally, I was the Chair of the Internet2 Multicast Working Group for seven years. In many of these efforts, I worked closely with numerous companies, including many in the routing/switching space. As part of my work in the IETF, I also wrote several RFCs and worked to standardize new network management protocols.

22.   I am an author or co-author of nearly 200 technical papers, published software systems, IETF Internet Drafts and IETF Request for Comments (RFCs).

23.   My involvement in the research community extends to leadership positions for several journals and conferences. I am the co-chair of the Steering Committee for the ACM Network and System Support for Digital Audio and Video (NOSSDAV) workshop and on the Steering Committees for the International Conference on Network Protocols (ICNP), ACM

Sigcomm Workshop on Challenged Networks (CHANTS), and IEEE Global Internet (GI)

Symposium. I have served or am serving on the editorial boards of IEEE/ACM Transactions on

Networking, IEEE Transactions on Mobile Computing, IEEE Transactions on Networks and

System Management, IEEE Network, ACM Computers in Entertainment, AACE Journal of

Interactive Learning Research (JILR), and ACM Computer Communications Review.

24.   I have co-chaired a number of conferences and workshops including the IEEE

International Conference on Network Protocols (ICNP), ACM International Conference on Next

Generation Communication (CoNext), IEEE Conference on Sensor, Mesh and Ad Hoc

Communications and Networks (SECON), International Conference on Communication Systems

and Networks (COMSNETS), IFIP/IEEE International Conference on Management of

Multimedia Networks and Services (MMNS), the International Workshop On Wireless Network

Measurement (WiNMee), ACM Sigcomm Workshop on Challenged Networks (CHANTS), the

Network Group Communication (NGC) workshop, and the Global Internet Symposium; and I

have been on the program committee of numerous conferences.

25.   Furthermore, in the courses I teach, the class spends significant time covering all

aspects of the Internet including each of the layers of the Open System Interconnect (OSI)

protocol stack commonly used in the Internet. These layers include the physical and data link

layers and their handling of signal modulation, error control, and data transmission. I also teach

DOCSIS, DSL, and other standardized protocols for communicating across a variety of physical

media including cable systems, telephone lines, wireless, and high-speed Local Area Networks

(LANs).

26.   I teach the configuration and operation of switches, routers, and gateways

including routing and forwarding and the numerous respective protocols as they are standardized

and used throughout the Internet. Topics include a wide variety of standardized Internet protocols at the Network Layer (Layer 3), Transport Layer (Layer 4), and above.

27.   In addition to having co-founded a technology company myself, I have worked for, consulted with, and collaborated with various technology companies, including IBM, Hitachi Telecom, Digital Fountain, RealNetworks, Intel Research, Cisco Systems, and Lockheed Martin. With many of these companies as well as numerous other companies in similar areas, I interacted with researchers and collaborated with peers at IETF meetings.

28.   I am a Member of the Association of Computing Machinery (ACM) and a Fellow of the Institute of Electrical and Electronics Engineers (IEEE).

29.   In my 35 years of experience with computer software, I have reviewed innumerable lines of source code written by many different programmers. And as mentioned above, I also teach the configuration and operation of various network devices (switches, routers, gateways), which includes topics related to command line interface computer programs and the technology upon which such programs are based. I also teach network programming classes and assign programming projects that I personally review and grade.

30.   As a result of my teaching, I am familiar with variations of command and program expression that arise when a set of engineers and/or programmers are asked to solve a problem. What I have found in my decades of experience is that engineers and programmers find many ways to write commands and programs to express solutions to the same problem.

31.   I also am familiar with tools used to assist in the detection of plagiarism or source code copying in a university setting. I have worked with UCSB to develop software tools for detecting plagiarism. For example, I was involved in developing the PAIRwise Plagiarism Detection Systems ("PAIRwise"). PAIRwise is a service that I helped invent that provides a

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variety of functions including comparing assignments against other assignments in a class and comparing assignments against the vast amount of data available on the Internet. The goal is to help professors detect plagiarism in their students' work.

32.   I also have conducted research; co-authored papers; and developed systems to support the detection of plagiarism through document comparison and similarity detection (*see, e.g.,* the papers and systems in my CV, specifically II.A.55, II.A.40, II.B.36, and II.E.15). I have also used tools like CopyFind, PAIRwise, and the Measure of Software Similarity (MOSS) program in my courses.

33.   Furthermore, I find programming an expressive, creative endeavor, just like technical writing. In both cases, although there is a purpose to be served, there are many ways to accomplish the goal, and a wide range of expressive choices in doing so.

34.   I attach as **Attachment A** my *curriculum vitae¸* which includes a more complete list of my qualifications.

B.   Materials Considered

35.   In forming my opinions, I have relied on my education and experience as described above.

36.   I have also reviewed and considered the materials cited in this reports as well as the materials listed in **Attachment B** to my opening report, the materials listed in **Attachment C** to this report, and the materials cited in all exhibits to my opening report, all of which are incorporated here by reference.

37.   I also have inspected and/or tested the switches, source code, and products set forth in my opening report.

38.   In addition to the materials specifically identified, I may provide further exhibits to be used as a summary of or support for my opinions.

39.   As I did in my opening report, I also have relied on conversation I had with Cisco employees including those identified below in this report and those identified in my opening report.

40.   I expect to testify at trial regarding the matters addressed in this report and any supplemental or amended report I may submit. I also expect to testify at trial with respect to matters addressed by experts testifying on behalf of Arista. I also may testify on other matters relevant to this case, if asked by the Court or by the parties' counsel.

41.   As I stated above, I have been asked to review the opening expert reports submitted by Dr. Black, Ms. Elsten, and Mr. Seifert on behalf of Arista. I have organized this report into various topics for which Arista's experts have provided one or more opinions. Arista's experts provided many similar opinions on the same topics, and so my rebuttals to those opinions are the same whether I specifically mention a particular expert's opinion or not. For example, all three expert reports that I was asked to review and respond to address the concept of "industry standards." I address those opinions below, but may not provide specific citations to all places in each of the three reports to which I am responding. My opinions rebutting specific topics apply equally to all similar opinions of Arista's experts.

III.   ARISTA'S EXPERT OPINIONS CONFIRM MY OWN OPINIONS

42.   In the hundreds of pages that Arista's experts collectively submitted, Arista's experts made various statements (and omissions) that bear on Arista's copyright infringement in this case. The admissions and omissions not only confirm my opinions that Arista intentionally and "slavishly" copied Cisco's copyrighted works but further confirm that Cisco's copyrighted

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works are original, creative, and that they are not and never have been part of any so-called industry standard.

43.   For example, Mr. Seifert confirmed that:

a.   manufacturers of routers have (and had) various choices when deciding what kind of CLI to implement, which supports my opinion that Cisco's copyrighted works are creative and that Arista—although it too had a choice to create its own CLI—chose instead to copy Cisco's copyrighted works[1]; and

b.   "[e]ngineers stereotypically enjoy complex interactions with machines, and network engineers are no exception in my experience," which supports my opinion that Cisco's "elegant" command expressions and hierarchies are creative and original as they went against the grain of stereotypical engineering.[2]

44.   Dr. Black confirmed that:

a.   "it is true Arista supports commands similar to those accused"[3] and, in fact, that they are "syntactically similar to commands accepted by the Arista CLI,"[4] which supports my opinion that Arista copied over 500 Cisco command expressions;

b.   user manuals—one of Cisco's copyrighted works—are creative and not part of an industry standard,[5] which supports my opinions;

c.   not only that there are alternatives to Cisco's CLI—*e.g.*, graphical user interfaces ("GUIs")—but that the creation of interfaces like GUIs is a creative endeavor subject

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[1]   Seifert Para. 60 ("Early on, other manufacturers of routers implemented their own CLI design for configuration and control.").
[2]   Seifert Para. 68.
[3]   Black Para. 165.
[4]   Black Para. 163.
[5]   Black Para. 113 ("User documentation for CLI commands differ by vendor").

to the professional preferences of developers,[6] which supports my opinions that even the decision

to create a CLI was part of an overall creative, expressive process that lead to Cisco's IOS CLI;

       d.   there are "certainly" design choices that are made when designing a CLI,[7]

which supports my opinion that Cisco's asserted command expressions are creative;

       e.   EOS provides alternative interfaces to the CLI that it copied from Cisco,

which proves that Arista did not have to copy Cisco and did not have to continue copying Cisco

after this case was filed because it has alternative interface options to choose from[8];

       f.   the same command expression can be associated with different functions,

which supports my opinion that Cisco's command expressions are creative and not purely

functional[9]; and

       g.   there are "cases where a Cisco IOS command produces the same net effect

from the user's perspective," which confirms my opinion that Arista copied Cisco's IOS output

displays.[10]

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[6] Black Para. 118 ("There are other user interfaces commonly used to facilitate interaction between a human and a computer. The most well-known of these would be a GUI. When an engineer or artist or web-designer designs a GUI, there are many choices about how to organize the interface into buttons, pull-downs, sliders, menus, text windows, etc., as well as what fonts to use, font sizes, graphical images, animations, and so forth. A GUI is a very 'content-rich' experience with a large array of design decisions for the creator. In fact, how best to design a user interface of this kind is considered a research area within Computer Science typically called 'User Interface Design.'"); *id.* at Para. 121 ("GUIs have sometimes been provided for selected Cisco products").

[7] Black Para. 119 ("Although there certainly are design choices to be made when designing a CLI…").

[8] Black Para. 126 ("EOS provides a CLI among other interfaces through which users can configure and monitor an Arista switch. For example, in addition to the EOS CLI, EOS provides a Linux "Bash shell" for accessing the underlying Linux operating system and extensions. The Bash shell is accessible in all command modes except EXEC. But the "bash shell" does not provide access to the majority of features available in EOS, and so is not an alternative to the EOS CLI.").

[9] Black Paras. 494, 495 ("some of the accused commands serve an entirely different functional purpose in Arista EOS than the Cisco IOS command that Cisco contends is similar").

45.   Ms. Elsten also stated that "Arista acknowledges that it supports certain CLI commands that are also supported by Cisco."[11] There is no disagreement among the experts that intentional and willful copying of Cisco's CLI commands has been committed by Arista.

46.   I also note that none of Arista's experts disputed any of the following:

i.   Arista copied Cisco's IOS technical documentation as set forth in the operative complaint and in my opening report regarding copying;

ii.   Cisco's IOS technical documentation are creative and original;

iii.   Cisco's IOS technical documentation is not part of an industry standard nor subject to Arista's fair use defense, let alone any of its other defenses such as *scenes a faire* or merger;

iv.   Arista copied Cisco's IOS help descriptions identified in Exhibits G and H to Cisco's interrogatory responses and in Copying-Exhibit 6 to my opening report ("Cisco help descriptions");

v.   Cisco's IOS help descriptions are creative and original[12];

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10   Black Para. 165.
11   Elsten at 30.
12   In fact, although Arista's experts had access to Arista and Cisco switches, had access to all of Cisco's interrogatory responses, and had access to all of Arista's employees who engineered the "cloning" of Cisco's IOS, Arista's experts chose not to analyze whether or not Arista copied the hundreds of help descriptions. Black Para. 4.   In fact, I find it strange that Dr. Black would say "no discovery was available" regarding these help descriptions, when he himself analyzed both Cisco and Arista switches and admitted "that 'helpdesc' text is readily available to anyone with a functional Arista switch" and that "nor is it necessary to review Cisco code to know what text Cisco EOS [sic] uses." Black Fn. 4. He also admitted, contrary to his "no discovery" excuse that: "I can confirm, however, that help descriptions on Arista software are available to anyone with a working Arista switch and are not confidential. By simply typing a '?' on an Arista switch one could have learned of the descriptions Cisco identified." Black Fn. 29. Despite having access to all of this "discovery," Dr. Black does not dispute that Arista copied Cisco's help descriptions.

      vi.   Cisco's IOS help descriptions are not part of an industry standard

nor subject to Arista's fair use defense, let alone any of its other defenses such as *scenes a faire*

or merger;

      vii.   Arista copied Cisco's IOS help screen;

      viii.   Cisco's IOS help screen is creative and original;

      ix.   Cisco's IOS help screen is not part of an industry standard nor

subject to Arista's fair use defense, let alone any of its other defenses such as *scenes a faire* or

merger;

      x.   Arista copied hundreds of Cisco's IOS command responses[13];

      xi.   Cisco's IOS command responses are creative and original[14]; and

      xii.   Cisco's IOS command responses are not part of an industry

standard nor subject to Arista's fair use defense, let alone any of its other defenses such as *scenes

a faire* or merger.

IV.   THERE IS NO INDUSTRY STANDARD CLI

    47.   In my opening report, I provided opinions that there is no industry standard for

CLIs and that Cisco's IOS copyrighted works, including its CLI, are not part of any industry

standard.[15] That section of my opening report is incorporated here by reference.

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[13]   Dr. Black only attempts to argue that they are not "original," though he fails to provide any evidence that would suggest they originated anywhere other than Cisco. Paras. 637-641. In fact, his only argument about originality is that certain single word commands such as "show" and "clear" are not original—but those single word commands are not at issue in this litigation, so his analysis is irrelevant.

[14] To the extent Dr. Black may claim that his opinions that the command responses are "functional," I disagree, and have provided opinions explaining the basis for my disagreement.

[15]   *See* Almeroth Opening Report Section VII.

48.   Arista's experts have provided their own opinions on this topic, and in this section

I provide my analysis and response to those opinions, which I disagree with. In sum, after

reviewing all of the evidence cited by Arista's experts, what I have found is that the evidence put

forth by Arista's experts confirms, contrary to how they attempt to interpret the data, that no

industry standard exists.

A.   Background Regarding Existing Technical Standard

49.   A standard is "any set of technical specifications that either provides or is

intended to provide a common design for a product or process."[16] Standard-Setting

Organizations ("SSOs") permit the creation of standard technologies to facilitate the

development of products that can work together.[17] As described above, I have been involved in

various SSOs (both as a participant, a contributor, and in a leadership capacity) during my career

and have extensive experience with the process of standardization. A typical key objective of

many SSOs is to facilitate interoperability between devices within a particular technology,

including communication technologies such as networking protocols. SSOs coordinate technical

standards in various industries, such as the communication and networking industries, where

SSOs include (for example) the Internet Engineering Task Force ("IETF")[18] and the Institute of

Electrical and Electronics Engineers ("IEEE").[19]

50.   Standards set forth by SSOs can serve an important function in certain areas of the

technology world. For example, parts/components companies (for example, companies making

pipe fixtures) must adhere to the standards set by end-user products companies (for example,

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[16]   Lemley, Mark, "Intellectual Property Rights and Standard-Setting Organizations,"
California Law Review, Vol. 90 (2002), p. 1896.
[17]   Lemley, Mark, "Intellectual Property Rights and Standard-Setting Organizations,"
California Law Review, Vol. 90 (2002), pp. 1892-1893.
[18]   Getting Started in the IETF (https://www.ietf.org/newcomers.html).
[19]   https://www.ieee.org/index.html

companies making faucets) to ensure compatibility. Without adherence to the standards, the parts/components will not fit the end-user products, thereby leaving the user with two ineffective products.

51.   The same basic principle applies for networking and communications, where different companies make devices and network equipment that must be able to communicate with each other. In fact, the foundation of networking is the ability of two or more devices to communicate with each other over a network.   In order to successfully communicate, some mutually agreed-upon means and procedures for communication must be used so that all the devices in the network can understand each other. Because there are many different device manufacturers throughout the world, networking SSOs—like the IEFT and IEEE, mentioned above—have been created in order to promulgate a standard set of communication procedures (also referred to as "protocols") to be used by device manufacturers across many geographical regions. By using the same set of communication procedures in the networking devices, devices from different vendors may interact with each other in order to support data communications.

52.   SSOs implement intellectual property rights ("IPR") policies that establish procedures to address the disclosure and licensing of technologies by their members. SSOs typically request disclosure of the existence of any relevant patents (or other technology) that might be claimed essential to a particular standard, and require the owner to agree in a written assurance that it will license the IPR on "fair, reasonable and non-discriminatory" ("FRAND") terms.   Such IPR policies are meant to protect the technology investments made by industry participants relying on established standards and to mitigate the risk of infringing on standard-essential intellectual property.   In my experience, many SSO IPR policies generally include the commitment to grant licenses to essential IPR for compensation to the IPR owner—they do not

mean that the IPR owner must give out its IPR for free or provide a royalty-free license. This is true, for example, of the IPR policies of two organizations with which I am familiar, the IETF and the IEEE Standards Association. So even if IPR is included as part of a standard, an IPR owner is entitled to compensation if others use that IPR. "Fair" does not mean "free." Furthermore, a participant in standards development does not lose its rights in its IPR just because the IPR becomes part of a standard. Indeed, the IETF clearly states that, "Contributors to the IETF (or their employers) retain ownership of the copyright in their Contributions."[20]

B.   There is no dispute that no standards body has adopted an industry standard for CLIs.

53.   I note that none of Arista's experts who opined on industry standard issues provided an opinion that there was an industry standard for CLIs that has been adopted by any SSO. Nor did Arista's experts provide any opinions or put forth any evidence that Cisco's IOS CLI is part of an industry standard—such as one from the IETF or the IEEE—or that Cisco ever attempted to make its IOS CLI into an industry standard. These facts are not disputed.

C.   Arista's experts' claim of a "de facto" industry standard is wrong.

54.   All three of Arista's experts contend that there is something called a "de facto" industry standard CLI, and that Cisco's IOS CLI is that "de facto" standard. I disagree. As I stated in my opening report, there is a great amount of diversity in the industry with respect to CLIs and command implementation, and I incorporate those opinions by reference.[21] Furthermore, as discussed in my opening report and below, most industry standards are focused

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[20]   https://tools.ietf.org/html/rfc5378#page-8 (Section 3.6).
[21]   Almeroth Opening Report Paras. 119, 120, 244, 245.

on machine-to-machine interactions and rooted in promoting interoperability, neither of which

are implicated by a CLI. For all of these reasons, there is no industry standard CLI.

1. Seifert

55.   Mr. Seifert appears to suggest that a "de facto" standard arises when "many"

vendors use a technology or when there is "widespread adoption":

> "Many network vendors coalesced around the now industry-standard CLI—
> Cisco's."[22]

> "Early examples of *de facto* industry standards include the software protocol
> TCP/IP, which was incorporated in University of California, Berkeley's version
> of UNIX, 4.2BSD—which itself became a *de facto* industry standard due to its
> widespread adoption."[23]

56.   I disagree with Mr. Seifert.

57.   Mr. Seifert defines neither of these terms. Nor does he explain what they mean.

Nor does he explain how "many" vendors "coalesced" around a standard CLI or provide any

data to explain just how "widespread" the adoption of UNIX, 4.2BSD was such that it became a

"de facto" standard.[24] Further, TCP and IP were each standardized by the IETF, *see, e.g.,* RFCs

791 and 793, respectively. Earlier documents for TCP and IP exist, almost to the earliest date of

creation, which describe attempts to define and standardize the protocols, *see,* e.g., RFC 675. As

for UNIX 4.2BSD, its use required a license.[25] His opinion thus makes no sense. How one

defines or determines what "many" means, or what "widespread adoption" consists of, is left to

speculation, subjective opinion and potential disagreement—which entirely defeats the purpose

of having a standard or calling something a standard in the first place. In the case of Cisco's

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[22]   Seifert Para. 11.

[23]   Seifert Para. 6.

[24]   Nevertheless, "de facto" standard typically means a "leading" product in the market—
it does not mean "industry standard" in a technical sense.

[25] http://www.oreilly.com/openbook/opensources/book/kirkmck.html

CLI, there is no evidence that Cisco's CLI was ever subject to any type of standardization process by an SSO. As I discussed in my opening report, the fact that Huawei was legally required to remove Cisco's CLI from its products based on a public lawsuit initiated by Cisco undercuts any notion of a "de facto" standard with respect to Cisco's CLI. Another critical fact that I addressed in my opening report is that Juniper has competed in the router and switch markets for a long time with a CLI that is very different from Cisco's CLI. The same is true for many other vendors. This is a very different situation than TCP/IP or UNIX examples given by Mr. Seifert, both of which involved SSOs (IETF and IEEE, respectively). Furthermore, there are numerous examples of popular user interface designs that are protected by intellectual property rights despite their popularity. Just because a particular user interface design is popular and widely adopted does not mean that it becomes a "de facto" standard and loses all protection. That would be contrary to the formation of SSOs and their IPR policies, as I discussed above.

58.   Moreover, Mr. Seifert's own re-telling of his experience at Wellfleet undermines his opinion that Cisco's IOS CLI is (or was) an industry standard. Indeed, Mr. Seifert explains how Wellfleet used a completely different interface for its routers—a graphical interface—that was markedly different that Cisco's IOS CLI: "The idea was to present the primary means of man-machine interaction through a graphics interface (GUI) on a centralized PC or workstation, while providing a simpler technician-level CLI for local control. From Wellfleet's perspective, Cisco presented a 'bottoms-up' view of the network, starting with the information available within each router. Our vision was to present a Wellfleet customer with a 'top-down' view of the network, peeling back the protocol-specific layers to offer a successively more comprehensive view of the underlying network and its behavior."[26] As Mr. Seifert himself

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[26]   Seifert Para. 68.

establishes, there was no industry need to use Cisco's IOS CLI—it was just one of many options available to vendors. And if his report is to be believed, even Wellfleet did not believe that there was an industry standard for interacting with networking customers, or, even if a standard existed, that Cisco's IOS CLI was that standard.

59.   Another problem with Mr. Seifert's industry standard opinions is that he offers no evidence to support various statements about why and how the so-called "de facto" standard emerged. Furthermore, none of these statements bears on any technical requirements of a network, networking protocol, or networking device. Mr. Seifert simply states that certain customers may like Cisco's CLI and if Arista copies Cisco's CLI that will make it easier for them to replace Cisco in the marketplace. He does not, however, state that a common CLI is required for any reason, including for operation and configuration of routers/ switches from different vendors or interoperability. I suspect that Mr. Seifert did not make that statement because he knows it is not true. As I stated in my opening report, CLIs—including Cisco's IOS CLI—are not required for interoperability between devices in the networking industry, nor is a standardized CLI required for users to operate and configure routers and switches from different vendors.[27] Multiple witnesses have confirmed that.[28] Mr. Seifert addresses none of that testimony and evidence in his report.

60.   Mr. Seifert's confusion about what is and is not an "industry standard" is further shown by the fact that his report inexplicably intermixes technical networking protocols (that may benefit, from a technical perspective, from industry standards) with more subjective, creative expressions like CLIs (that do not require industry standards). For example, Mr. Seifert writes:

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[27]   Almeroth Opening Report Para. 252.
[28]   Almeroth Opening Report Para. 252.

"As previously mentioned, once an Ethernet [sic] was deployed and made operational in a customer location, it would not be unusual to have three or more protocols running over the same Ethernet, each supporting a separate group of computing systems and associated devices. The effect of this 'ships in the night' phenomenon was to introduce additional operational complexity on the network engineers assigned to keep everything working properly."[29]

61.   Mr. Seifert's discussion of Ethernet protocols is irrelevant and actually highlights the critical difference between networking protocols such as Ethernet and the creative user interfaces that may be used to configure Ethernet equipment such as CLIs and GUIs. His discussion has nothing to do with CLI command expressions, output elements, documentation, or any other copyrighted elements that Arista has copied from Cisco. None of these elements—which frame the basis for Cisco's copyright infringement claims—are relevant to Ethernet protocol functionality. To the extent Mr. Seifert is attempting to suggest that having different Ethernet protocols is similar to having different user interfaces for network devices, he is comparing apples to oranges, and I disagree that such a comparison is relevant at all.

62.   Mr. Seifert also gives some significance to the fact that the term "industry standard" may appear in certain documents. I disagree with Mr. Seifert and his opinions that rely on putting any significance on these documents, given the context and nature of those documents. In my opinion, as I discussed in my opening report, informed by my experience as a technologist active in standards development as well as by common sense and customary use of the English language, the use of terms like "industry standard" and "industry leading" in marketing materials is Cisco's way of explaining that it is offering its proprietary (and successful) CLI along with its network devices. This is akin to promoting a product or

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[29]   Seifert Para. 67.

technology as an industry-leading, gold standard not as a "de facto" industry standard.[30]

Moreover, Cisco should not be penalized for creating a product that is popular and a market-leader; if anything, the incentive for creating such products (like IOS and its CLI) should flow the other way.

63.   The facts relating to the products in the industry confirm that CLIs are not used as part of any "de facto" industry standard to support interoperability between different networking devices or to provide a common way of operating or configuring routers and switches across multiple vendors. This is confirmed by the fact that Cisco has never committed its CLI to an industry standard; Cisco's IOS CLI has never been adopted by an SSO; and there are many vendors offering different user interfaces (*e.g.*, Juniper) in the networking industry, including even Arista, who offers a Linux interface as an alternative to the CLI it copied from Cisco. Furthermore, many elements that Arista copied are not even alleged to be part of any standard. For example, the technical documents Arista has admitted to copying are not alleged to be part of a standard. Neither are the outputs or command help descriptions.

64.   Finally, Mr. Seifert claims that "Cisco was not only calling its CLI an "industry standard" to sell products; it actually believed it."[31] This is not correct, to the extent that Mr. Seifert is suggesting that Cisco was dedicating its CLI to the public as part of an industry standard. Cisco has sued to enforce its copyrights over its CLI in the past, confirming that Cisco

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[30]   Seifert Para. 75-77; Roy Deposition Tr. at 184:17-21 ("Q. Okay. Have you ever heard people within Cisco refer to the Cisco CLI as a de facto industry standard? A. I have heard people say Cisco has industry-leading CLI, but not exactly the standard phrase which you are citing."); Jiandani Deposition Tr. at 154:12-17 ("Q. Do you consider Cisco's CLI to be a competitive advantage to Cisco? A. I view it to be a gold standard. So it's one where we are popular products. We have – we have these -- many people use these products. So they've become a gold standard in the industry."); Pletcher Deposition Tr. at 211; *see also* http://www.cisco.com/c/dam/en_us/solutions/industries/docs/gov/ cisco_csr_in_aws_whitepaper.pdf ("industry-leading Cisco IOS®").
[31]   Seifert Para. 78.

has always believed that its copyrighted works and IOS CLI are proprietary to Cisco. In fact, when Cisco learned that Huawei copied Cisco's IOS CLI, Cisco sued Huawei for copyright infringement, and Huawei was forced to change its CLI as a result of that litigation.[32] The same is true here. When Cisco learned of Arista's widespread infringement, it sued to enforce its property rights.[33] And the intellectual property rights at issue here are not just commands, as Mr. Seifert seems to suggest—Cisco has alleged (and I have found) widespread copying of technical documents, command outputs, hierarchies, modes, prompts, and help screens—which shows that Arista has copied the entire look and feel of Cisco's IOS CLI.

65.   I also have reviewed Mr. Seifert's conclusions regarding his understanding of the "history" of Cisco's CLI.[34] To the extent that Mr. Seifert is attempting to suggest that Cisco's copyrighted works and IOS CLI are not original or were not created by Cisco, I disagree. As I stated in my opening report, it is my opinion, and all of the available evidence indicates, that the Cisco copyrighted work including Cisco's IOS CLI are original works. As I explained in my opening report, Cisco has provided an incredible amount of detailed evidence showing that even down to the asserted multi-word command expressions, Cisco created them as well as the documentations, hierarchies, modes, prompts, screen outputs, and help descriptions associated with Cisco's IOS CLI.

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[32]   I disagree with Mr. Seifert's statement that "the message to the industry surrounding the Huawei litigation was that Cisco would enforce its IP rights in its source code, but if all one did was use CLI commands, Cisco had no dispute with such conduct." Seifert Para. 84. If Mr. Seifert had read the Huawei complaint or related documents, he would know this is not true. Cisco certainly alleged that Huawei stole Cisco's source code, but that was just one element of the case. Cisco also claimed infringement of its commands and Huawei in fact changed its commands as a result of the litigation. Mr. Seifert's statement is therefore just factually wrong, and his conclusions stemming from his misunderstanding are wrong as well.

[33]   Seifert Para. 84.

[34]   Seifert Para. 70.

66.   In Footnote 43 of his report, Mr. Seifert refers to the IBM PC and states, "IBM allowed many other vendors to replicate its PC, which served the very useful purpose to IBM of establishing the IBM PC as the de facto standard for personal computing." Mr. Seifert then cites to an IBM Archives article. I have reviewed that article and see nowhere where it discusses the idea that IBM allowed others to copy the IBM PC as a way of establishing its platform as a de facto standard. Rather, the article describes the development process and ends with the release of the product. As to the facts of the IBM PC, Mr. Seifert is completely wrong. First, IBM attempted to develop a proprietary hardware architecture called the Micro Channel Architecture (MSA) and created a licensing program. Clone makers used an alternate architecture. Thus, Mr. Seifert is wrong that there was a single monolithic standard for a personal computer, and he is wrong that IBM allowed copying. Second, IBM copyrighted its Basic Input/Output System (BIOS), and while they published it to allow software developers to create applications for its computers, they attempted to assert their copyright rights to prevent unlicensed cloning.[35] Mr. Seifert's analysis is flawed and cannot be used to support his conclusions.

2.   **Elsten**

67.   Arista also submitted a report from Ms. Elsten who—although she has no technical expertise—opined and commented on certain "industry standard" issues. I disagree with Ms. Elsten's opinions and comments.

68.   For example, Ms. Elsten wrote that "Cisco has encouraged and promoted the support of its CLI commands and structure as an industry standard. 1. Support of 'Cisco-like CLIs' is widespread in the relevant market and is not confined to Arista."[36] I disagree. I have not seen any evidence that any competitor in the "relevant market" has engaged in widespread,

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[35]   http://computemagazine.com/the-history-of-the-ibm-personal-computer/.
[36]   Elsten at 28.

intentional copying like Arista has. Even the "evidence" of other vendors' use of similar multi-word command expressions relied on by Ms. Elsten (and other Arista experts) shows that Arista's use of Cisco's multi-word command expressions is distinctively high when compared to others in the market. And command expressions are just one of Cisco's copyrighted works that Arista copied. Ms. Elsten does not account for the other copyrighted elements Arista copied to create a clone of Cisco's user interface, nor does she address whether she believes others in the market also copied those elements.

69.   Ms. Elsten also states: "It is also important to note that where a command is not present in another vendor's CLI, that vendor may not support the feature or features corresponding to that command—in other words, the vendor may use no command for that feature because it does not offer the feature, as opposed to using a different command."[37] This may very well be true, but Ms. Elsten provides no evidence to support it. So it is impossible to know what "vendor" she is referring to; what command she is thinking about; how prevalent such a factor might be; etc.

70.   Like Mr. Seifert, Ms. Elsten commented on Cisco's Huawei settlement. By doing so, Ms. Elsten appears to be suggesting that although Arista might have copied Cisco, it has done so in a way that is acceptable to Cisco.[38] I disagree. She ignores all of the evidence that Arista intentionally copied Cisco in order to create a clone of Cisco's IOS. And in Arista's effort to clone IOS, Arista copied much of what is needed to understand and use a switch—from documents to screen outputs to help outputs to commands (etc.). To suggest that Arista's copying might be acceptable based on a nearly exclusive focus counting command expressions

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[37]   Elsten at 29.
[38]   Elsten at 32.

thus ignores the intentional copying of the entire look and feel of IOS, as well as all of the other elements that Arista copied beyond the commands.

71.   Ms. Elsten's focus on "5%" of command copying also is misleading. It ignores the fact that the earlier versions of EOS show command overlap in the 50-60% range, which is far greater than the 10-20% range Ms. Elsten uses. And the reason that—if taken as true—the command overlap might be 5% today is because Arista added commands over time which has "hidden" just how extensive its copying was; it ignores that, for example, there are many single word/letter/character commands that are irrelevant to the case because all of the commands at issue here are multi-word command expressions; and it ignores that today's version of EOS is merely a derivation of the original EOS versions that show copying in some instance of over 60%, which shows that what Arista copied was important to Arista. I provide further details on this topic below in connection with my discussion of Dr. Black's report.

72.   Like Mr. Seifert, Ms. Elsten comments on the benefits of "standardization" and identifies four such "benefits."[39] While I do not disagree as a general matter that for certain technologies standardization can be beneficial, to the extent that Ms. Elsten suggests that any of the benefits she identifies bear on CLIs, I disagree. For example, having an industry standard CLI would not "[a]llow equipment made by different companies to work together" nor would it "[p]rovide an indication of performance expectation."[40] Neither would it "[p]rovide a base level of known quality for some aspects of operation." A CLI is simply not relevant for these considerations. For example, equipment made by different companies, including those with different CLIs, work together in existing networks. Even to the extent an efficient CLI can affect performance, that would be a consideration based on the design of the CLI and not because

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[39]   Elsten at 34.
[40]   Elsten at 34.

different equipment shared the same CLI. Finally, Ms. Elsten's last comment does not really make sense, not least of all for the reason that she does not identify whose expectations she is describing. More importantly, CLIs do not provide indications of expectations, period. As I explained above and in my opening report, there is no need for an industry standard CLI. And that is evident by the fact that no SSO has ever adopted one, and there is diversity among CLIs. In my opinion, the message to the networking industry from the SSOs is clear: you can use the industry standard networking protocols to interoperate, but you are free to develop your own user interfaces (whether it is CLI or GUI or another type of interface) to compete in the marketplace and offer distinct value propositions to customers.[41]

73.   Ms. Elsten also comments on the fact that documents that may refer to Cisco's IOS as "industry standard."[42] I disagree with Ms. Elsten's opinions and comments. As a general matter, Ms. Elsten makes the same observations as Mr. Seifert, which I discussed previously. Since I explained why Mr. Seifert is wrong above, I incorporate those critiques and opinions here by reference. Moreover, Ms. Elsten conveniently overlooks that the documents she focuses on clearly indicate that Cisco believed its IOS to be proprietary—it has copyright notices that tell the reader that Cisco claims ownership in the works discussed in the document, *e.g.*, "All contents are Copyright © 1992–2006 Cisco Systems, Inc. All rights reserved. Important Notices and Privacy Statement."; "© 2006 Cisco Systems, Inc. All rights reserved."; and "Copyright 2006 Cisco Systems, Inc. All rights reserved."

74.   Ms. Elsten opines that "Cisco also created several white papers for the Cisco IOS that discussed the "industry-standard" nature of the command-line interface. For example, Cisco

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[41]   Almeroth Opening Report Section VII (discussing various interface options vendors can employ).

[42]   Elsten at 34-35.

white papers for the Cisco IOS XR 2.0 and 3.0 releases both promoted the CLI as industry

standard to its customers."[43] I disagree with Ms. Elsten's interpretation of this document. The

term "modular" is used to describe Cisco's CLI (not "industry standard"). Nevertheless, even if

Ms. Elsten's reading of the "white paper" was correct, for the reasons stated previously in this

report and in my opening report, I disagree that has any bearing on whether or not the Cisco

copyrighted works and IOS CLI are part of any industry standard.

75.   Finally, Ms. Elsten states (by citing to testimony from two former Cisco

employees) that Cisco regarded its CLI as an industry standard.[44] I disagree with Ms. Elsten. As

I stated in my opening report,[45] the overwhelming evidence shows that there is no industry

standard CLI,[46] and I have seen no evidence to suggest that Cisco ever proposed its CLI to a

standards-setting body or that Cisco requires others in the industry to use its CLI. According to

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[43]   Elsten at 35.

[44]   Elsten at 35.

[45]   *See* Almeroth Opening Report at Section VII.

[46]   *See, e.g.*, Deposition Testimony of Jayshree Ullal (Arista President & CEO) at 68:14-69:4, 208:7-210:16, 217:11-21, 223:12-19; Deposition Testimony of Kenneth Duda (Arista CTO & SVP of Software Engineering) at 58:8-59:24, 70:4-17, 73:23-75:16, 93:20-95:2, 195:18-197:8, 323:22-324:19, 326:6-329:11; Deposition Testimony of Anshul Sadana (Arista SVP of Customer Engineering) at 93:20-103:4, 281:12-20, 108:17-109:4, 242:17-247:19, 267:2-271:24, 272:24-273:5; Deposition Testimony of Adam Sweeney (Arista VP of Software Engineering) at 257:12-17, 159:9-160:9, 161:8-16, 161:25-162:7, 163:12-164:2, 165:1-6; Deposition Testimony of Lincoln Dale (Arista Distinguished Engineer) at 272:20-274:24, 215:23-216:7, 216:14-217:4, 222:4-13; Deposition Testimony of Hugh Holbrook (Arista VP of Software Engineering) at 84:13-17, 147:25-148:13, 248:8-12; Deposition Testimony of Mark Foss (Arista SVP of Global Operations & Marketing) at 100:10-12, 100:23-101:2, 112:11-13; Deposition Testimony of Berly Tr. at 140:25-141:3; Deposition Testimony of Lorenz Redlefsen Tr. at 40:1-9; Deposition Testimony of Dale Deposition; Deposition Testimony of Bechtolsheim; Deposition Testimony of Lang; Deposition Testimony of Berly; Deposition Testimony of Giancarlo; Deposition Testimony of Foss; Deposition Testimony of Hull; Deposition Testimony of Pech; Deposition Testimony of Redlefson; Deposition Testimony of Sollender; *see also* the deposition testimony identified in response to Arista's Interrogatory No. 21, which is incorporated here by reference.

Cisco, when the term "industry standard" is used in Cisco's marketing materials, it refers to "the popularity and quality of Cisco's CLI in Cisco's industry leading products."[47]

3.   **Black**

76.   According to Dr. Black, what defines a "de facto" industry standard in the context of this case is the "widespread adoption of the disputed CLI functionality across the networking industry."[48]   And according to Dr. Black "[t]he EOS CLI is often referred to as an 'industry standard' CLI because some of the more common CLI commands, widely supported by most networking vendors, are supported by EOS."[49]   As explained in more detail throughout this report and in my opening report, I strongly disagree with Dr. Black's opinions that there is any industry standard CLI. In fact, Dr. Black's opinions are contradicted by the data he provides in his appendices, which show that there is a great amount of diversity in the industry and that there has not been "widespread" adoption of Cisco's copyrighted works. Moreover, none of Dr. Black's appendices address copying in the "industry" with respect to the technical documents, display outputs, or help description outputs, which are all part of Cisco's copyrighted works.

77.   Like Arista's other experts, Dr. Black also attempts to support his opinions by relying on documents that characterize Cisco's IOS CLI as an "industry standard."[50] For the

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[47]   *See, e.g.*, Cisco's responses to Arista's Interrogatory No. 9; *see also, e.g.*, Roy Deposition Tr. at 184:17-21 ("Q. Okay. Have you ever heard people within Cisco refer to the Cisco CLI as a de facto industry standard? A. I have heard people say Cisco has industry-leading CLI, but not exactly the standard phrase which you are citing."); Jiandani Deposition Tr. at 154:12-17 ("Q. Do you consider Cisco's CLI to be a competitive advantage to Cisco? A. I view it to be a gold standard. So it's one where we are popular products. We have – we have these -- many people use these products. So they've become a gold standard in the industry."); Pletcher Deposition Tr. at 211; *see also* http://www.cisco.com/c/dam/en_us/solutions/industries/docs/gov/ cisco_csr_in_aws_whitepaper.pdf ("industry-leading Cisco IOS®").

[48]   Black Paras. 82, 83, 90.

[49]   Black Para. 127.

[50]   Black Paras. 124-125.

reasons stated above and in my opinion report (which are incorporated here by reference), I

disagree.

D.   The data that Arista's experts rely on disproves their theory that a "de facto" industry standard exists.

78.   Mr. Seifert opines that: "The majority of vendors across the industry have adopted

a CLI similar to Cisco's, which they actively market to customers who in turn have been

conditioned to expect a familiar industry-standard CLI with non-Cisco products."[51] Mr. Black

provides similar opinions[52] and attaches appendices that purportedly support his opinions.   I

disagree with both Mr. Seifert and Dr. Black.

79.   Dr. Black provides a summary of his command counting in Paragraph 180, which

purports to cover both command expressions and "command fragments." It is not entirely clear

what Dr. Black exactly means by "command fragments" or how this impacts his calculations—

Dr. Black fails to explain with any amount of clarity his specific methodology, though he

suggests it may refer to commands he does not believe are supported word-for-word by Arista.

Nevertheless, for purposes of my response I will assume that Dr. Black's calculations are

accurate and reflect the multi-word command expressions that Arista copied, unless otherwise

noted below.

80.   Here are the calculation summaries Dr. Black provided in Paragraph 180:

> i) Dell's CLI for its networking products has supported more than half of
> the disputed CLI commands in this lawsuit. At least 268 of the accused
> CLI commands (or command fragments) are found in Dell and Force10
> command reference manuals.
> ii) At least 268 of the accused CLI commands (or command fragments)
> are found in Brocade's command reference manuals for its networking
> products.

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[51]   Seifert Para. 80.
[52]   Black Paras. 179-181..

iii) At least 218 of the accused CLI commands (or command fragments) are found in Juniper's command reference manuals for its JUNOSe (E Series) line of networking products.

iv) At least 163 of the accused CLI commands (or command fragments) are found in Foundry Networks' command reference manuals for its networking products (Foundry was acquired by Brocade, and no longer exists).

v) Over 300 of the accused CLI commands (or command fragments) are found in D-Link's command reference manuals for its networking products.

vi) At least 223 of the accused CLI commands (or command fragments) are found in Edge-Core's command reference manuals for its networking products.

vii) Several other vendors, including HP, Extreme Networks, Alcatel (and ALU), Lenovo/IBM/BNT (all of whom use the "Industry Standard CLI" or ISCLI), Oracle/Sun, NETGEAR, Procket Networks, and Adtran show in their documentation that they support well over 100 of the accused CLI commands (or command fragments) each.

81.   There are various problems with Dr. Black's data and methodology. To start, based on my review of the materials in this case and my knowledge of the switching industry and switching vendors, Dr. Black has omitted at least 20 switching vendors from his analysis (if not more – this is a conservative estimate and does not even include all routing vendors). This is important because it represents a significant percentage of the "industry." Accordingly, in my opinion none of Dr. Black's opinions about "industry standard" CLIs or command expressions, hierarchies, modes, and prompts (etc.) are statistically relevant. If one assumes for the sake of argument that there are 20 vendors omitted (a conservative estimate), that means that Dr. Black has failed to analyze or provide data for roughly 50% of the industry. As such, none of his opinions about an "industry standard" CLI can possibly be accurate because he failed to actually survey the industry. Instead, he surveyed a self-selected fraction of it.

82.   Moreover, Dr. Black's report discusses the following 20 "vendors"[53]:

1. Adtran
2. Alcatel/ALU
3. Allied Telesis
4. Avaya/Nortel/Lucent
5. Brocade
6. Dell/Force 10
7. D-Link
8. Edge-Core
9. Ericsson/Redback
10. Extreme /Enterasys
11. Foundry[54]
12. HP /Aruba /3Com
13. Juniper/Unisphere (JUNOSe and JUNOS)
14. ISCLI (Lenovo IBM, BNTI)
15. NETGEAR
16. Nexthop
17. Oracle / Sun
18. Procket Networks
19. Quagga / Cumulus
20. DEC

83.   But Dr. Black's analysis in Appendix G only analyzes a subset (17/20) of these vendors:

* Adtran, Alcatel/ALU, Allied Telesis, Avaya, Brocade, Dell, D-Link, Edge-Core, Ericsson, Extreme, Foundry, HP, ISCLI, Juniper, NETGEAR, Procket Networks, Sun/Oracle

84.   Dr. Black fails to explain why DEC, Quagga/Cumulus, and Nexthop were not included in Appendix G.

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[53] Because Dr. Black appears to have combined multiple different vendors and counted them as a "single" vendor to perform his analysis, this is based on my best efforts to parse through his analysis. What Dr. Black seems to have done is combine different vendors' products so long as at some point the vendors merged.

[54] I note that in the body of his report Dr. Black combines Brocade and Foundry together but in Appendix G he separates them. Because Dr. Black separated those entities in Appendix G, I will do the same here.

85.   Furthermore, in Arista's response to Interrogatory No. 10, Arista identified additional vendors that it contended use "similar" command expressions to those at issue in this case. There are at least five vendors that are on Arista's list that do not appear in Dr. Black's report:

1. Bay Networks
2. Check Point Software Technologies
3. Darkstar/XKL
4. F5 Networks
5. Perle Systems

86.   Dr. Black never explains why he ignored or chose to analyze a subset of the vendors he and Arista identified. The only reasonable conclusion is that he did not address those other vendors because the data from them was worse than the data Dr. Black relied on to support his opinions. The data that Arista provided in its response to Interrogatory No. 10 confirms that to be true, as the omitted venders (both from Interrogatory No. 10 and from Dr. Black's additional omissions) use a very small fraction of the command expression that Arista copied (on average roughly 5.4%):

Vendor	Interrogary No. 10 Command Overlap	Percentage Overlap (versus 514 and 509 command expressions)
Bay Networks	2	0.38% - 0.39%
Checkpoint Technologies	74	14.4% - 14-5%
Darkstar/XKL	33	6.4% - 6.5%
DEC	5	0.97% - 0.98%
F5 Networks	24	4.6% - 4.7%
Perle Systems	29	5.6% - 5.7%
Quagga/Cumulus[55]	--	--

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[55]   I could not locate data for Quagga/Cumulus in Arista's interrogatory response or in Dr. Black's Appendix G, despite the fact that Dr. Black spent multiple paragraphs discussing Quagga/Cumulus and purported to address certain "overlapping" commands in Paragraph 426. Black Paras. 423-426.

87.   Another problem with Dr. Black's Appendix G is that it only includes 447 command expressions, instead of the 514 that Dr. Black claimed to have analyzed, or the 509 command expressions that I concluded Arista copied. There is no explanation in Dr. Black's report for this discrepancy. And the result of omitting 60+ commands (over 10%) obviously skews Dr. Black's data and any conclusions one might be able to draw from it, which makes it unreliable in the context of this case in my professional opinion.

88.   Although none of Arista's experts set forth any specific way to determine what percentage of command expression adoption is sufficient to rise to the level of a purported "de facto" industry standard, Dr. Black did state that "[t]he EOS CLI is often referred to as an 'industry standard' CLI because some of the more common CLI commands, <u>widely supported by</u> <u>**most** networking vendors</u>, are supported by EOS."[56] What Dr. Black's data shows is that, however, "most" of the industry vendors do not use "most" of the multi-word expressions at issue—in other words, Dr. Black's own data does not even meet his own definition of a "de facto" industry standard. To the contrary, if his data proves anything, it confirms that there is no "de facto" industry standard when it comes to CLI interfaces and that there is significant diversity of CLIs across the industry.

89.   Here is a summary of Dr. Black's data:

Vendors Supporting Commands	Number of CLI Commands Associated with Each Group of Overlap
17	2
16	6
15	6
14	13
13	6
12	19
11	23

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[56] Black Para. 127.

10	25
9	35
8	37
7	30
6	32
5	39
4	43
3	36
2	52
1	43

90.   This does not support Dr. Black's opinions. To the contrary, it supports my

opinion that there is no industry standard CLI.

91.   First, Dr. Black's data shows that a majority of vendors (9/17 or 53%) do not use

a significant majority (312/447 or 70%) of the multi-word command expressions at issue.[57] But,

again, Dr. Black omitted vendors. And when those vendors—who on average had overlap of a

small fraction of command expressions (6%)—are added into the calculation the data reflects

that an even higher percentage of vendors are not using the majority of the command expressions

at issue in the case.

92.   Second, based on Dr. Black's data, only 135 command expressions (30.2% or a

minority) are used by a majority of the vendors that Dr. Black provided data for (9/17 or 53%).[58]

93.   Third, when a smaller group of vendors that Dr. Black addressed is analyzed (and

here analyzing not 509 or 514 commands but 359), the data shows that three out of five vendors

(75%) do not use a majority of the multi-word expressions Dr. Black provided data for (221/359

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[57]   For this calculation, I used the 447 commands Dr. Black analyzed in Appendix G. If
the denominator is changed to 509 or 514, the percentage are 61.3% and 60.7%, respectively.
[58]   Again, for this calculation, I used the 447 commands Dr. Black analyzed in Appendix
G. If the denominator is changed to 509 or 514, the percentage are 26.5% and 26.2%,
respectively.

or 62%). Even this "small" selection of vendors does not meet Dr. Black's definition of a "de facto" industry standard:

APPENDIX G – Subset of Vendors (HP, Brocade, Alcatel-Lucent, Juniper, Extreme)	
Vendors Supporting Command	Number of Disputed CLI Commands Associated with Each Group of Overlap
5	22
4	38
3	78
2	120
1	101

94.   Accordingly, the data shows that Arista copied many commands that cannot be considered "industry standard" even by Dr. Black's own definition, since those commands are not used by "most" of the vendors. And since most of the copied commands are used by less than "most" of the vendors, those commands are not—by Dr. Black's own definition—"industry standard." Dr. Black's data thus proves that Arista's copying went far beyond anything that can be considered "industry standard" even under Arista's reasoning.[59]

95.   Dr. Black's opinions regarding "modes" and "prompts" (Appendix C) suffer from many of the same problems. As I stated above, Dr. Black only analyzed what appears to be a random sample of "vendors," not the entire industry. As a result, his data, analysis, and conclusions do not support that there is any industry standard for modes or prompts either.

96.   With respect to "hierarchies," in addition to the problems identified above, Dr. Black's analysis oddly focuses only on single-word and two-word hierarchies. But Dr. Black

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[59]   Furthermore, as I stated in my opening report, Arista copied numbers commands from non-IOS operating systems that Arista does not believe are "industry standard." This is further proof that Arista did not merely use an "industry standard" CLI but instead focused on slavishly copying Cisco. Almeroth Opening Report Paras. 242-244.

opposed to any of the other copyrighted elements that Arista copied. I disagree with Arista's experts. I incorporate my opinions from my opening report about the creativity and originality of the various elements of the Cisco copyrighted works here by reference.

A.   Creativity

100.   Mr. Seifert provided what appear to be various opinions about creativity relating to Cisco's copyright works, for example:

a. Switches of the type at issue in this case embody a large number of functional features, of which the CLI commands are only one.	17[68]
Given the limited number of characters that could be displayed on a single command line (generally <80), the nature of the commands and the types of information that could be displayed on the terminal necessitated that each command be limited in its scope and impact.	68

101.   Mr. Black also provided various opinions about his views on the creativity of Cisco's copyrighted works or CLIs generally, for example:

Although there certainly are design choices to be made when designing a CLI the choices are relatively few: what prompt to use, what modes to use, what keywords should be used and in what order, etc.	119
Moreover, it really was not and is not possible to make a dramatically different CLI given the inherent constraints on that interface method: there are just not that many choices to be made on how to organize a finite set of words into a set of short commands.	119
With respect to the disputed CLI command responses, as I discuss further in this Report, those asserted responses consist of descriptive phrases regarding switch features and functionality. The substance of the phrases derive from the functionality of the device and industry terminology used to define that functionality, which can be seen from a review of the many exemplary command responses shown in the third-party vendor manuals I analyzed for this Report.	192
With respect to the disputed CLI command responses, as I discuss further in this Report, those asserted responses consist of descriptive phrases regarding switch features and functionality. The substance of the phrases	192

[68] All of the numbers in the right hand column in this and all following, similar tables refers to the paragraph number or page number where these statements can be found.

derive from the functionality of the device and industry terminology used to define that functionality, which can be seen from a review of the many exemplary command responses shown in the third-party vendor manuals I analyzed for this Report.	
I have considered all of these non-literal aspects of Cisco's asserted works and am of the opinion that these aspects comprise (together with the other recognized CLI commands, arguments, parameters and other command responses not asserted) a method of operation for controlling a Cisco device. Individually, some of these aspects of the Cisco CLI are nothing more than a concept or a system.	522
As Cisco has described the asserted CLI command hierarchies, they are not expressive, but are merely methods of operation and systems for organizing commands in an extensible manner, for the functional purpose of ensuring consistency and usability of the CLI.	530
The use of a command hierarchy is a system for performing that function--namely, identifying to the user the specific networking protocol on which a particular command will operate. In other words, as Mr. Lougheed explained it, "developing a hierarchy is a way of managing complex entities that have many similarities and a few differences."	534
Furthermore, as noted below, the vast majority of these common keywords are, themselves, not original to Cisco but rather reflect common industry terms. The "IP" hierarchy reflects various commands beginning with that word which indicate functions that are related to the "IP" protocol, as opposed to other protocols. As such, in my opinion there is nothing about Cisco's hierarchy claim that is anything other than a system or method of operation of grouping related functions.	535
And the selection of functions within a particular "hierarchy" is, necessarily, a reflection of the underlying functionality.	535
The modes that Cisco identify as copied protected expression, and the corresponding prompts that indicate the respective modes, are another aspect of the overall method of operation of accessing functionality of the network device on which the software is running.	536
The fact that all vendors implement this idea in essentially the same way is a strong indication that the use of command prompts is a system or method of operation. A "mode" is simply an indication of the internal state of the parser indicating what method within the parser should be applied to text the user enters.	538
To the extent Cisco identifies certain excerpts of command responses as copied protected expression, those excerpts are also part of a system or method of operation. Command responses are screen displays typically provided to inform a network administrator of the status of the device or the network…. In all cases, however, the excerpts are part of an overall system or method of operation, namely obtaining and organizing data regarding state.	539

102.   I disagree with Mr. Seifert and Dr. Black. As I explained in my opening report (which I incorporate here in response by reference), the Cisco copyrighted works are creative and original works.[69] Command expression creation is a subjective endeavor.[70] Command expression creation is impacted by an individual author's own professional preferences and judgment.[71] Many Cisco and Arista employees/executives have testified under oath that they agree.[72] There is no technical reason that specific words, syntaxes, or expressions must be used by vendors, let alone Cisco's IOS CLI.[73] The same is true of the various other copyrighted elements that Arista copied, such as the hierarchies, technical documents (which Arista's experts never addressed), display screens, help screens, and modes/prompts.

103.   Furthermore, as I stated in my opening report, command expressions are not purely functional in nature,[74] neither are the other works that Arista has copied. The command expressions at issue are neither particularly efficient nor perfect from any functional perspective either.[75] Arista's experts have confirmed my opinions as well. Arista's experts opined that different functionality can be associated with the same command expression in different vendors.[76] In other words, expressions are not programmatically or intrinsically linked to a

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[69]   Almeroth Opening Report Paras. 50-52, 101-117, 121.
[70]   Almeroth Opening Report Paras. 101-120.
[71]   Almeroth Opening Report Paras. 101-120.
[72]   Deposition Testimony of Adam Sweeney (Arista VP of Software Engineering) at 175:15-23, 217:12-218:8, 184:5-185:18, 186:21-187:6 (Jan. 29, 2016) (calling the process of command expression creation "very subjective"); Deposition Testimony of Kenneth Duda (Arista CTO & SVP of Software Engineering) at 150:16-151:9, 176:16-177:16, (Feb. 12, 2016); Deposition Testimony of Jayshree Ullal (Arista President & CEO) at 253:14-254:7; Deposition Testimony of Lincoln Dale at 148:19-149:11, 150:4-25, 152:9-25, 153:15-154:9; Anshul Sadana Deposition Tr. at 135:18-136:12, 137:11-138:1, 157:6-24; Depositions of Kirk Lougheed.
[73]   Almeroth Opening Report Para. 110, 112.
[74]   *E.g.*, Almeroth Opening Report Para. 118.
[75]   *Id.*
[76]   *E.g.*, Black Paras. 494 ("Moreover, some of the accused commands serve an entirely different functional purpose in Arista EOS than the Cisco IOS command that Cisco contends is

single function. What the evidence shows is that the keywords and syntax that make up a

particular command expression are in no way tied to any technical requirements, let alone any

"method" as Arista's experts contend. The fact certain key words such as "ip" might suggest to a

user that there is a relationship to "Internet Protocol" is irrelevant—there is no technical

requirement that any such relationship exist, and it was Cisco's subjective determination to

create expressions that may include those links for users.[77] For instance, "ip" could mean

"identity pointer" or "intellectual property" or any other new term Cisco created; and if "Internet

Protocol" is what is meant by "ip," there are other ways to abbreviate that phrase that one could

have selected (*e.g.,* instead of "ip" the word "net" could be used or "l3" for Layer 3, the network

layer).

> 104.   Arista's own witness Adam Sweeney confirmed this to be true as well:
>
> 15 Q. Mr. Sweeney, based on your experience
> 16 working with CLI command syntax both at Cisco and at
> 17 Arista, would you agree that coming up with CLI
> 18 syntax for a particular command is very subjective?
> 19 A. It certainly is subjective, yes.
> 20 Q. And that means that different engineers
> 21 could come up with different ideas for the proper
> 22 CLI syntax for the same functionality, correct?
> 23 A. Yes.[78]
>
> 12 Q. Right. So at the end of the day,
> 13 selecting CLI syntax is a judgment call, true?
> 14 A. Yes.
> 15 Q. And what you were laying out are some of
> 16 the principals and style guidelines; but as you
> 17 said, these aren't mandatory rules, at the end of
> 18 the day, the Arista engineers should talk about it

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similar."), 555 ("I note that some of the Arista CLI commands that Cisco accuses in this lawsuit
are similarly not used in the same way that the Cisco CLI uses them.").

   [77]   To be clear, to the extent a link exists, it exists in the user's mind insofar as command
expression helps a user remember the expression and other expressions within a hierarchy.

   [78]   Deposition Testimony of Adam Sweeney (Arista VP of Software Engineering) at
175:15-23 (Jan. 29, 2016).

19 and then use their judgment; is that right?

20 A. Yes.[79]

105.   I also disagree with Arista's experts' opinions that displays are wholly functional

in nature.[80] CLI screen displays are textual (sentences and paragraphs) and may also have

organizational features (tables, lists). Like any other piece of writing, they are not dictated by

anything technical, and are thus unhinged from the functionality underlying a network device.

For example, the "help screen" that Arista copied textually and organizationally has no

underlying "functional" relevance—it explains to a user when help can be requested and the

styles of help offered:

```
Switch>help
Help may be requested at any point in a command by entering
a question mark '?'.   If nothing matches, the help list will
be empty and you must backup until entering a '?' shows the
available options.
Two styles of help are provided:
1. Full help is available when you are ready to enter a
   command argument (e.g. 'show ?') and describes each possible
   argument.
2. Partial help is provided when an abbreviated argument is entered
   and you want to know what arguments match the input
   (e.g. 'show pr?'.)
```

(Cisco's IOS Help Screen)

```
localhost#help
Help may be requested at any point in a command by entering
a question mark '?'.   If nothing matches, the help list will
be empty and you must backup until entering a '?' shows the
available options.
Two styles of help are provided:
1. Full help is available when you are ready to enter a
   command argument (e.g. 'show ?') and describes each possible
   argument.
2. Partial help is provided when an abbreviated argument is entered
   and you want to know what arguments match the input
   (e.g. 'show pr?'.)

localhost#
```

(Arista's Identical EOS Help Screen)

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[79]   *Id.* at 217:12-218:8.

[80]   *E.g.*, Black Para. 192.

106.   To the extent that a single command may have an associated, unique output does mean that the output is not creative or expressive.[81] Neither does the fact that an output may reflect certain configuration settings of an underlying device make the display not expressive or creative—the words on the display and their organization (*e.g.*, a table, list, or in a specific paragraphs) are not necessarily dictated by function or configuration settings.

107.   I also disagree that potential limitations on the number of characters in a command line—which Mr. Seifert says is "generally <80"[82]—has any bearing on this case. First, it is not true. Command lines are not limited to 80 characters being displayed. Second, even if the statement is true, there is no reason why Cisco could not build a command line interface that accepts more than 80 characters—so it is not a technical constraint on command expressions. Third, his argument is akin to saying that a book or poem is not creative or expressive merely because there are 26 letters in the English alphabet and thus there are a finite number of ways to arrange those letters. This obviously makes no sense. And neither is it true that what is input as a command expression limits in anyway what can be "displayed on the terminal" as Mr. Seifert opines. By way of example, the "help" screen discussed above is not limited by the input—a question mark. The words, sentences, and layout reflect the creative and expressive decisions that Cisco made and are not technically tied to the "?" command.   The same is true for the multi-word command expressions that Arista copied. Fourth, I would note that even if a command line was limited to 80 characters, that is not a justification to claim the

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[81]   Furthermore, in providing my responses to Arista's experts opinions on "functionality," I am not suggesting that because something relates to or performs a function it is somehow not protectable by copyright.   All computer programs perform functions, and I have been informed and understand that computer programs are nevertheless copyrightable.

[82]   Seifert Para. 68.

CLI (or the commands that it accepts) is not creative. It is well known that many poetry styles use limited lines of text, syllables, etc., (*e.g.*, haiku, senryū) and yet those are nevertheless creative and expressive. Fourth, this argument does not apply to the copyrighted elements Arista copied that are not command expressions.

108.   Dr. Black also contends the Cisco's Parser Police Manifesto "places several practical and technical constraints on the addition of new CLI commands in Cisco IOS."[83] I disagree. As I stated in my opening report, the Parser Police allowed for collective discussions of Cisco engineers about word choices for new commands.[84] It was a "very subjective" process:

> 17 A. It states:
> 18 "That's why we have this list."
> 19 Q. And you wrote those words?
> 20 A. I believe so.
> 21 Q. And the list there is the parser-police
> 22 list, correct?
> 23 A. Yes.
> 24 Q. Okay. And can you read the next sentence
> 25 into the record.
> 1 A. It states:
> 2 "Review in this list gives us a chance
> 3 to work towards consistency within this
> 4 very subjective space."
> 5 Q. And, again, you wrote those words?
> 6 A. I think so.
> 7 Q. And you believe that those are true
> 8· statements?
> 9 A. Yes.
> 10 Q. Okay. And when it says: "very subjective
> 11· space," what is that referring to?
> 12 A. I assume it means the space of CLI syntax.
> 13 Q. And you say in the next sentence:
> 14 "In my opinion..."
> 15 Can you read that.
> 16 A. "In my opinion, syntax consistency with
> 17 features that have similar function is

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[83]   Black Paras. 603-604.

[84]   *E.g.*, Almeroth Opening Report Para. 107; Remaker Deposition Tr. at 29:18-31:18.

18 very important."[85]

The document called the "Manifesto" itself is merely a set of "guidelines" and "best practices" for the creation of new commands.[86] It is not a rule book that explains how commands must be created—it provides stylistic suggestions.[87] Accordingly, I disagree with Dr. Black's claim that the Manifesto placed any restraints on command creation—the document itself as well as testimony about the Manifesto prove otherwise.

109.   In sum, no standard, protocol, RFP or other technical document dictates the expression of a command expression or the content of any hierarchy, technical document, display screen, help screen, prompt, or mode. Arista's experts have come forward with no such evidence, and I am not aware of any such evidence.

B.   Originality

110.   Mr. Seifert also provided certain opinions relating to the originality of the Cisco copyrighted works, for example:

As discussed further in report Section IV.B below, available evidence indicates that CLIs are sometimes (but not always) identified among dozens of discrete features discussed in customer RFPs for switches of the type at issue.	17
Many aspects of the Cisco CLI are very similar to those defined by Digital's DCL. Some of Cisco's keywords are found in even earlier products, such as the Proteon p4200 Gateway. A review of the user manuals from Cisco, Digital, and Proteon from the late-80s/early-90s illustrate commonalities in command structure, hierarchies, keywords, argument lists, etc., particularly with respect to Digital. This is not	63

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[85]   Deposition Testimony of Adam Sweeney (Arista VP of Software Engineering) at 184:17-185:18 (Jan. 29, 2016).

[86]   Remaker Deposition Tr. at 27:11-18:2, 37:4-7; CSI -CLI- 00754391 ("in practice parser -police has no formal 'clearing' criteria'"; encouraging engineering to "think" and "envision" when developing commands; using dashes instead of underscores "is a purely aesthetic thing").

[87]   *Id.*

surprising given that, for example, Digital's TOPS-20 operating system was the operating system on which the original Cisco router software was developed for the Stanford University Network, The Tops-20 command was issued to connect a terminal to a remote computer system over the ARPAnet is an example of the use of a telnet syntax and English words long before the advent of Cisco's CLI.	
Note the use of a "show" command followed by multiple keywords within one command as implemented by the Proteon CLI.	66
Cisco's CLI design evolved from other works that preceded and influenced its development, including that of Digital, Proteon, and UNIX (particularly 4BSD).	70

111.   Dr. Black provided certain opinions relating to the originality of the Cisco

copyrighted work as well, for example:

Based on my analysis below and in this Report, it is my opinion that the asserted CLI commands consist primarily of terms taken from (and defined and used in) published industry standards from standards setting bodies like the IETF and IEEE, from documents like Informational RFCs that describe *de facto* industry practices or industry best practices, and/or widely and commonly used industry terms relating to the CLI command's functionality.	543 545
Based on my analysis below and in this Report, it is my opinion that several fundamental aspects of the IOS CLI that Cisco is asserting against Arista were copied and taken directly from other CLIs that existed in non Cisco systems and software.	547
Several disputed commands, like "show users" and "terminal length," were also supported by legacy DEC products.	571
Cisco witnesses confirmed that they were already familiar with networking protocols and parlance before adding CLI commands.	614 -618

112.   I disagree with both of Arista's experts for various reasons. To start, neither

expert addresses the fact that Cisco provided a significant amount of evidence establishing the

originality and creation of Cisco's copyrighted works including its IOS CLI.[88]

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[88]   Almeroth Opening Report Para. 260.

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113.   Instead of addressing or rebutting that evidence, Arista's experts argue that because certain individual words appear both in some command expressions and in earlier-dated RFCs, technical literature, or in prior networking systems, Cisco's copyrighted works are not original.   This analysis is flawed, and I disagree with it and the subsequent conclusions.

114.   With respect to the command expressions, the major flaw in Arista's experts' analysis is that they have failed to show that the multi-word command expressions that Arista copied appear in any of the literature or products they cite to. In other words, what they have shown is that some of the individual words may have existed previously. But what they failed to do is provide evidence that the multi-word command expressions (let alone hierarchies)—as copyrighted by Cisco and as asserted in this case—existed in any of those documents or products.   Since Cisco is not contending that Arista copied any single word commands, Arista's experts' focus on a "single word" analysis is irrelevant to determining whether Cisco's copyrighted works are original. Arista's argument is analogous to someone contending that a book or poem is not original because it is comprised of words, and those words were known before the author wrote the book. That is illogical.

115.   At most, Arista's expert Dr. Black points to two expressions (out of the 500+ expressions Arista copied from Cisco) that he claims were "supported" by older products from DEC—"show users" and "terminal length."[89] But Dr. Black cites no evidence showing that Cisco did not come up with those command expressions on their own, let alone that Cisco did not create them first. In any event, these two expressions represent a tiny fraction of the copyrighted work that was admittedly copied by Arista from Cisco.

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[89]   Black Para. 571 (discussing "show users" and "terminal length").

116.   Furthermore, none of Arista's experts' arguments are directed to the technical

documents, hierarchies, display outputs, and help descriptions that Arista copied. (At most, they

are directed to commands, modes, and prompts.) Arista's experts effectively picked one or two

elements from Cisco's copyrighted works and erroneously attack those elements by using a straw

man argument—their "single word" approach. Meanwhile, they have ignored the many other

elements that also are part of Cisco's copyrighted works and thus have conceded originality in

those elements. In fact, Arista's own CEO, Jayshree Ullal, has testified under oath that it was

improper for Arista to have copied excerpts from Cisco's copyrighted documents.[90] Many of

those copied excerpts describe the infringing display outputs and command hierarchies that are

still present in Arista's EOS-based products.[91] As I explained in my opening report, it is my

understanding that merely using an electronic medium rather than physical medium does not

negate the act of copying.

VI.   *SCENES A FAIRE,* MERGER & SHORT PHRASES

117.   I understand that Dr. Black also provided certain opinions relating to the defenses

of *scenes a faire*, merger, and "short phrases." I disagree with Dr. Black's opinions and

conclusions; none of these defenses change any of my opinions.

118.   I have been informed that, under the doctrine of *scenes a faire*, elements of a

work are not entitled to protection against infringement if they are standard, stock, or common to

a topic, or if they necessarily follow from a common theme or setting.[92] I also have been

informed that in the computer context, *scenes a faire* may include program elements that are

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[90] Almeroth Opening Report Para. 157; Ullal Dep. (ITC) Tr. at 58:1–12, 61:22–25.
[91] Almeroth Opening Report Para. 158-167.
[92]   In this context, I understand that "common" does not mean common to a group of
people or companies but instead common as is trite, unoriginal, clichéd, etc.

dictated by extrinsic considerations such as the mechanical specifications of the computer on which a particular program is intended to run, or widely accepted programming practices within the computer industry. I further understand that *scenes a faire* is evaluated at the time of creation of the expression.

119.   I have been informed that under the merger doctrine, courts will not protect a copyrighted work from infringement if the idea underlying the allegedly infringed copyrighted work can be expressed in only one way. The merger doctrine provides that, when there are a very limited number of ways to express an idea, the idea may be said to "merge" with its expression, and the expression may not be protected as a result. I further understand that a merger defense is evaluated at the time of creation of the alleged expression, and not at the time of the infringement.

120.   Finally, I have been informed that where an entire work is only an individual word or a short phrase such as a name, title, or slogan it may not be subject to copyright protection under the short phrases doctrine, unless it exhibits sufficient creativity. I also understand that not all courts apply this doctrine and those that apply it do not extract short phrases from the work as a whole in conducting the analysis (as Arista's experts have done), but I discuss it here for the sake of completeness.

121.   Dr. Black made a number of comments related to these three defenses, for example:

Within the context of a CLI for a networking switch, there are a host of external forces that severely constrain one's choice of words to use in the commands. An important indicator of what Cisco's CLI authors followed when arriving at commands is the Parser Police Manifesto described above. It advises to use terms that are familiar in the industry, only use acronyms accepted in the industry, and urges that commands be self-explanatory to avoid frustrating users. It also cautions against commands that lead to "dead-ends" where it is impossible to extend a feature with a	643-45

new sub-feature, and warns of "collisions" that can occur when the shortened "command-completion" version of one command is the same as another, causing scripts to fail. These are all external factors that limit the practical options available when selecting the words for a CLI command.	
CLI commands are, in essence, a short-cut for a more complete description of the functionality that the command invokes. This obvious constraint of CLI command choice was driven by Cisco's business need to keep customers happy.	646
While it is true that one could potentially use a different word order for certain commands, because these commands are typically no more than three or four words long (nor can they be much longer if they are to be usable), there are very few available reasonable options for such short phrases. For example, one could imagine replacing some non-technical terms with synonyms (the most obvious example being using "display" instead of "show"). But there are a very limited number of reasonable synonyms for the concept of "showing" the state of a device or network.	649
Apart from need to follow conventional industry nomenclature, I would summarize the other key external factors that constrain the choice of command keywords as follows: English usage, brevity, clarity, extensibility and efficiency in the parsing of the commands. I discuss each of this in further detail below.	650
For these "show" and "clear" commands, the structure of them is simply common English usage: [verb] + [protocol] + [argument]. This syntax is driven in part simply by the way English speakers think.	651
As confirmed by numerous witnesses, the purpose of a CLI command is to allow access to the desired function with as little difficulty as possible. Therefore brevity is another external factor limiting the selection of commands.	652
Need for clarity: This is not to say that a CLI using "ip system" could not function; it could. But there are plainly external factors that make "host" a more attractive term than the others.	653
Need for extensibility: Therefore a fundamental tenet of software design is that, to the extent possible, new features can be added with minimum disruption to the existing installed base. Software engineers call this "extensibility," and it has been a factor in CLI selection for as long as there have been CLI commands.	656
I am also aware that, at times, engineers have debated variations on proposed CLI commands, whether via Parser Police or otherwise. For example, there were discussions with the Parser Police regarding certain LLDP commands associated with Mr. Patil. And there were also Parser Police discussions relating to commands associated with other Cisco engineers. The essence of these email debates regarding command selection further demonstrates the external constraints that exist in arriving at CLI commands. Participants in the debates challenge one another about whether a particular command will be understood by users,	665

or whether it will pose some problem regarding extensibility, or whether it will be confused with some other command. The alternatives that the participants in these debates consider are not evidence of a creative process. Rather, in my opinion, these debates show engineers attempting to reach consensus on functional superiority, balancing the different external constraints described above.	
CLI commands are, of necessity, short phrases. As such, they allow for few reasonable alternatives, as explained above. Cisco engineers agree.	668
Each valid command is parsed until it can be associated with only one unique function (otherwise it is an invalid or incomplete command) and then it is executed.	669
As shown in **Appendix K**, once one filters out the terminology that comes from legacy operating systems and from standard industry usage including IETF RFCs and specifications, there are few words left of all of the asserted command keywords. The assessment of creativity, in my opinion, starts and ends with what Cisco engineers may have contributed to this body of vocabulary that does not merit copyright protection.	670

122.   I disagree with Dr. Black for the reasons stated in my opening report and in my discussion above that the Cisco copyrighted works in this litigation are original, creative, and expressive.   All of my opinions (already expressed) apply here because Dr. Black makes no new arguments in his discussions on *scenes a faire*, merger, and short phrases.

123.   As I stated above, even if the Cisco copyrighted works do relate to or perform a function or method, I understand that does not mean that they are not protectable by copyright. All computer programs perform functions and methods, and I understand those are protectable works under the law. Nevertheless, as I have previously stated, there is nothing necessarily or purely functional about Cisco's copyrighted works.[93] They are not necessarily directed to any "method" either. Neither are there any constraints on what can be included in a command expression, hierarchy, or any of the other copyrighted elements at issue in this case.[94] None of the elements of the Cisco's copyrighted works are "names, titles, and slogans."

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[93]   *See infra* Para. 45.f.; Almeroth Opening Report Para. 118.
[94]   Almeroth Opening Report Para. 101-118.

124.   Further, with respect to command expressions—the copyrighted element Dr.

Black focuses on the most—Arista's Mr. Sweeney confirmed the creation process is a very

subjective process, which negates the possibility that any one expression can merge with any one

idea or that expressions are inherently functional or confined by technological constraints:

5 Q. Well, let's just have that one sentence
6 read in.
7 A. Okay. It states:
8 "I agree that CLI naming is very
9 subjective."
10 Q. You wrote those words, correct?
11 A. I believe so.
12 Q. And you agree with that statement, true?
13 A. The "very" is maybe a little much, but,
14 yes.
15 Q. Okay. And then you say -- well, why don't
16 we have you read the next sentence into the record.
17 A. It states:
18 "That's why we have this list."
19 Q. And you wrote those words?
20 A. I believe so.
21 Q. And the list there is the parser-police
22 list, correct?
23 A. Yes.
24 Q. Okay. And can you read the next sentence
25 into the record.
1 A. It states:
2 "Review in this list gives us a chance
3 to work towards consistency within this
4 very subjective space."
5 Q. And, again, you wrote those words?
6 A. I think so.
7 Q. And you believe that those are true
8· statements?
9 A. Yes.
10 Q. Okay. And when it says: "very subjective
11· space," what is that referring to?
12 A. I assume it means the space of CLI syntax.
13 Q. And you say in the next sentence:
14 "In my opinion..."
15 Can you read that.
16 A. "In my opinion, syntax consistency with
17 features that have similar function is

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18 very important."[95]

21 Q. If somebody said to you, Mr. Sweeney,
22· there's only one way, only one way to express a
23· command syntax for a particular CLI command to be
24· used in a -- network equipment, would you agree with
25· that statement?
1 A. No.
2 Q. And why not?
3 A. 'Cause it's not true.
4 Q. And based on your experience, you know
5 it's not true, true?
6 A. Yes.[96]

125.   Many other witnesses have testified similarly, including Kirk Lougheed.[97]

126.   For these reasons—as well as the reasons stated in my opening report and in this

report—I disagree that the doctrines of *scenes a faire*, merger, or "short phrases" are applicable

here.

VII.   FAIR USE

127.   I understand that Arista asserts as an affirmative defense the doctrine of "fair

use." I have been informed that a defendant may reproduce another's copyrighted work if doing

so constitutes fair use. I understand in determining whether the use made of a work is a fair use,

courts consider: 1. the purpose and character of the use, including whether such use is of a

commercial nature or is for nonprofit educational purposes; 2. the nature of the copyrighted

work; 3. the amount and substantiality of the portion used in relation to the copyrighted work as

a whole; and 4. the effect of the use upon the potential market for or value of the copyrighted

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[95]   Deposition Testimony of Adam Sweeney (Arista VP of Software Engineering) at 184:5-185:18 (Jan. 29, 2016).
[96]   Deposition Testimony of Adam Sweeney (Arista VP of Software Engineering) at 186:21-187:6 (Jan. 29, 2016).
[97]   Almeroth Opening Report Para. 112.

work. I also understand that a defendant (here, Arista) has the burden of proving this defense by

a preponderance of the evidence.

128.   In support of Arista's "fair use" affirmative defense, Dr. Black provided certain

opinions, for example:

Cisco does not allege that Arista's EOS copies source code from IOS or any other Cisco operating system. The architecture and source code underlying Arista EOS were independently developed by Arista engineers. I am not aware of any allegations by Cisco that any of the Arista source code underlying EOS was copied from the Cisco IOS source code, and I have seen no evidence in my review of source code in this litigation to support any such allegation of source code copying. Cisco's copyright allegations directed to the functionality of the Arista EOS CLI is not directed at any literal EOS source code, but instead at non-literal functionality of the EOS CLI in its operational aspects.	672
Transformation -- Based upon all of my observations set forth above, it is my opinion that Arista's alleged use of the asserted CLI aspects is a transformative use because of the fundamentally different and novel Arista hardware and software that Arista developed independently, and because the asserted CLI aspects are merely a means of accessing or controlling some of that innovative technology. By using the asserted CLI aspects in this way, Arista has altered the asserted "expressions" with new expression, meaning, or message, at least in the following ways discussed below.	673
First, the Arista hardware design has delivered performance substantially above its competition for many years	674 675
As explained above, the EOS CLI is only one aspect of EOS as a whole, and is merely an interface that people use to in order to *access* the engine (*i.e.*, the networking functionality) of EOS. The commonality of CLI commands is provided solely for the purpose of the user experience, not for the execution of the functions of EOS.	676
In short, there is nothing "under the hood" of the Arista's EOS, or EOS CLI parser that is remotely similar to Cisco's registered works.	678

129.   In support of Arista's "fair use" affirmative defense, Ms. Elsten also provided

certain opinions, for example:

I understand that approximately 514 CLI commands currently appear to be at issue in this case. I further understand from Mr. Black that Arista's EOS contains approximately 13,000 to 14,000 CLI commands.	19-20

Therefore, the CLI commands at issue represent less than 5% of the CLI commands used for Arista's switches. As stated earlier, the CLI commands at issue similarly represent less than 5% of those used for Cisco's switches.	

130.   I disagree with Dr. Black's and Ms. Elsten's opinions and conclusions for various reasons, as explained below.

A.   "The purpose and character of the use, including whether such use is of a commercial nature or is for nonprofit educational purposes."

131.   I start by noting that neither Dr. Black nor Ms. Elsten contend that Arista's use of Cisco's copyrighted works is for one of the enumerated fair use purposes that is protected by the copyright laws—criticism, comment, news reporting, teaching (including multiple copies for classroom use), scholarship, or research. Neither expert contends that Arista uses Cisco's copyrighted works for educational purposes or, on the other hand, that Arista does not use Cisco's copyrighted works for a "commercial" purpose.

132.   It also is my understanding that Arista is a for-profit business and does, in fact, use Cisco's copyrighted works for a commercial purpose.[98] As I explained in my opening report, I understand that Arista provides products, software, and technical support incorporating Cisco's copyrighted works to its distributors and/or customers so that they use Arista's EOS and its CLI.[99] As I also explained in my opening report, Arista knows that its distributors and customers purchase its products to use, reproduce, distribute, and/or publicly display EOS.[100] For example, Arista has stated that at least 80% of its customers consider the EOS CLI (which incorporates

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[98]   CSI-CL-02099053; CSI-CLI-00355093; CSI-CLI-00355164; CSI-CLI 00358000; CSI-CLI-01300636.
[99]   Almeroth Opening Report Para. 256.
[100]   *Id.* at Paras. 257-258.

Cisco's copyrighted works) to be an important factor in their decisions to purchase Arista's products.[101]   Arista also markets the similarity between its products and Cisco's copyrighted works in marketing and other public materials as a selling point for customers.[102]   And, as I explained in my opening report, Arista also provides training and support specifically for its EOS CLI.[103]

133.   I have seen nothing that would suggest to me that Arista's use of Cisco's copyrighted works is different in any way than Cisco's use of those works. The purpose of Arista using Cisco's copyrighted works is the same as Cisco's. Arista has used and continues to use Cisco's copyrighted works in the same type of software as Cisco (a network device operating system), with the same general type of hardware as Cisco (network devices, including switches and routers), to perform many of the same functions as Cisco (routing and switching), and sells to customers in the same or similar ways as Cisco. In fact, Arista's CEO views Cisco as a "fierce competitor" in the market,[104] and if a customer were to purchase an Arista device with EOS they would (to my knowledge) have no reason to also purchase a Cisco device with IOS for the same application. Thus, in my opinion Cisco's copyrighted works and Arista's EOS operating system are used for the same purpose.

134.   Further, in my opinion Arista's use of Cisco's copyrighted works is not "transformative" because Arista has not created anything new out of Cisco's copyrighted works. Arista has instead admittedly and "slavishly" copied Cisco's copyrighted works, in many cases word-for-word, even copying grammatical errors and/or commands that Arista believed to be

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[101]   *Id.*Para. 75.
[102]   *Id.* at Paras. 75, 257.
[103]   *Id.* at Para. 77, 256.
[104]   *Id.* at Para. 69; CSI-CLl-00357842 at CSI-CLI-00357851

inferior to available alternatives (as I explained in my opening report).[105] Arista also uses at least

the command expressions for an identical purpose of providing the command-line interface to a

networking device that <u>competes directly</u> with Cisco's networking devices.[106]

135.   Arista also has explained that it saved development costs by copying Cisco's

copyrighted works: "Since I helped build the enterprise, I would never compete with Cisco

directly in the enterprise in a conventional way. It makes no sense. It would take me 15 years

and 15,000 engineers, and that's not a recipe for success."[107] Arista has further explained that its

use of Cisco's copyrighted CLI was to compete directly with Cisco:

> "[A] Cisco CCIE expert would be able to use Arista right away, because we have
> a similar command-line interface and operational look and feel. Where we don't
> have to invent, we don't.[108]"

> Arista has learned to "[p]rovide familiar interfaces to ease adoption" including a
> "standard CLI that … retains familiar management commands" so much so that
> "80% [of Arista customers] tell us they appreciate the way they can leverage their
> deep [Cisco] IOS experience, as they can easily upgrade an aging [Cisco] Catalyst
> infrastructure to Arista."[109]

> "Familiar management interfaces, standard CLI … It's been very helpful for our
> customers to be able to rapidly adopt our products and integrate them into their

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[105]   Almeroth Opening Report, Section VI Evidence of Copying.

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[107]   *See, e.g.*, Adam Lashinsky, "An Ex-Cisco Exec Reflects," Fortune (Mar. 20, 2014),
available at http://fortune.com/2014/03/20/an-exciscoexec-reflects/.

[108]   John Gallant, "How Arista Networks Got Out In Front of the SDN Craze," Network
World (Feb. 22, 2013).

[109]   Posting of Kenneth Duda to Arista EOS Central, "Linux as a Switch Operating
System: Five Lessons Learned" (Nov. 5, 2013), *available at* https://eos.arista.com/linux-as-a-
switch-operating-system-five-lessons-learned/.

environments … that our switches provide a familiar management interface so their existing tools and processes, screen scraping, automation, continue to work just as they did before."[110]

"The familiar EOS command-line interface (CLI) avoids retraining costs."[111]

136.   Dr. Black's arguments that Arista's use of Cisco's copyrighted works is different than Cisco's use because Arista has developed a different operating system, uses different "merchant silicon," or because a few commands may have different underlying functionality do not change my opinions. By copying Cisco's copyrighted works, Arista has cloned— intentionally—the "look and feel" of Cisco's copyrighted works. A user operating an Arista device would have no knowledge that the underlying code and hardware might be different than Cisco's—and they would, in my opinion, have no reason to care. The Arista user experience is identical to Cisco's, and thus Arista is using Cisco's copyrighted works exactly as Cisco does, and it has done so, according to its own executives, intentionally.[112]

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[110]   Arista, *EOS Bits & Bytes - Episode 1 - Lessons Learned While Building a Network OS on Top of Linux*, Arista EOS Central - Video Library (Jan. 30, 2014), at 6:55–7:56, *available at* http://eos.arista.com/wpcontent/ themes/aristaeos/video-lightbox.php?vid=ttp6lavHKGo.

[111]   Arista, *EOS: An Extensible Operating System.*

[112]   *See, e.g.*, Deposition Testimony of Jayshree Ullal (Arista President & CEO) at 304:12-307:24 (defending statements that Arista tries to mimic the "operational look and feel" of Cisco, and that "Where we [Arista] don't have to invent, we don't."); Deposition Testimony of Kenneth Duda (Arista CTO & SVP of Software Engineering) at 45:2-15 ("Arista has many CLI commands in its interface that [were] copied from Cisco's CLI interface"), 45:24-46:5 ("I don't know what you mean 'a coincidence.' Obviously they were copied. That wasn't a coincidence, no."), 47:19-24 (Q: "Mr. Duda, isn't it true that you and others at Arista slavishly copied the Cisco CLI commands?" A: "I've said things to that effect and it's true in the sense that I meant it."), 154:3-155:5, 202:17-25, 221:3-24, 234:9-13 (Q: "You've told customers, sir, that if you have scraping or automation tools that work for Cisco's CLI, you could take those and run it against Arista's switches; you've said that, right?" A: "I believe so, yes."), 297:14-303:22, 310:11-311:7, 321:15-25; Deposition Testimony of Anshul Sadana (Arista SVP of Customer Engineering) at 207:7-209:14, 233:3-236:17, 251:3-252:9, 277:14-278:15; Deposition Testimony of Adam Sweeney (Arista VP of Software Engineering) at 210:7-211:21, 130:14-131:4, 131:14-131:24, 308:3-18, 309:2-8, 317:4-16; Deposition Testimony of Lincoln Dale (Arista Distinguished Engineer) at 300:16-301:17; Deposition Testimony of Mark Foss (Arista SVP of

137.   In fact, Arista has produced evidence in this case indicating that it copied not just the CLI interface and related elements from Cisco, but that it copied numerous features from Cisco's competing products in order to create Arista products that compete directly with Cisco.[113] In fact, Arista admitted under oath that it has engaged in a pattern of copying features and product functionality in order to compete with Cisco.[114] I understand that the Administrative Law Judge in a related ITC investigation found that Arista has engaged in copying with respect to certain patented features of Cisco products.[115] All of this undisputed evidence of Arista's intentional copying of Cisco's features and CLI interface design demonstrates that Arista has acted willfully in a competitive manner and did not engage in a "transformative" use of the copyrighted works from Cisco. To the contrary, Arista used Cisco's copyrighted works in products that compete directly with Cisco using the same "look and feel" and largely similar set of product features, which were also copied from Cisco, in order to take customers away from Cisco. It is my opinion that this type of use is not transformative in nature and that it reveals the impropriety of Arista's conduct.

138.   There is additional evidence that I have seen that suggests to me that Arista acted willfully to compete with Cisco, not to transform the use of Cisco's CLI in a fundamentally different way. For instance, as I set forth in my opening report (e.g., Paragraphs 135 to 154), there are numerous documents showing that Arista employees had considerable access to Cisco's

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Global Operations & Marketing) at 130:4-10 ("[T]he CLI commands on our switch are identical to Cisco lOS, so there should be no learning curve to get it configured"), 135:1-22, 171:8-15.
    [113] ARISTANDCA13165595 ("FeatureRequests" tab); *see also* ANI-ITC- 944_945 3663673; ANI-ITC- 944_945 3930871.
    [114] *E.g.*, Almeroth Opening Report Paras. 135-154.
    [115] Certain Network Devices Related Software and Components Thereof (I), Inv. No. 337-TA-944 USITC Pub. 575521 (Feb. 2, 2016) (Initial Determination).

copyrighted works and products[116] and they admitted to copying Cisco's CLI and documentation

intentionally (I incorporate those documents and my analysis here by reference). By way of

example only:

      ■   ███████████████████

      b.   "We actually copied it slavishly. You know it's like—even the things we

thought were really silly, we went ahead and copied them anyway . . . . "[118]

      ■   ███████████████████████

      ■   ████████████████████

      ■   ███████████████████████████

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      f.   Copying Cisco was "the practical thing to do"[122]

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      ■   ███████████████████████████████

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[116]   *E.g.*, Deposition of Sadana (Rough) Tr. at 74:1-23, 74:24-75:14, 75:15-77:9 (May 27, 2016) (discussing Arista's repository of "Cisco competitive content"); *see also* Sadana Exhibit 1303.

[117]   ANI-ITC-944_945-3599339.

[118]   Packet Pushers Clip (Audio File) (Duda Exh. 274).

[119]   ARISTANDCA 12060827.

[120]   ARISTANDCA10499890 at ARISTANDCA10499893.

[121]   *Id.* at ARISTANDCA10499891.

[122]   Bechtolsheim Dep. (ITC) Tr. at 240:7–21.

[123]   *Id.* at ARISTANDCA10499890.

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       k.   "Are you denying, sir, that you told Arista customers that your CLI is just like Cisco's CLI? A. I'm not denying that."

       l.   "The first claim is in the technical-documentation area, and they say that we have copied pieces of their documentation. We have done a thorough review over the weekend, and to the best of our ability we can see that—this is something that is completely unacceptable to me . . . . I own up to that. That's a mistake."[127]

       m.   "Q: And you believed that that was improper behavior, right? A: Absolutely."[128]

       139.   In my opinion Arista's CTO's blog postings also confirm that Arista's corporate leaders do not respect other company's intellectual property rights and, in fact, encourage others to act as Arista has here.[129]

      B.   **"The nature of the copyrighted work"**

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[124] ARISTANDCA10499890.
[125] ARISTANDCA1199299.
[126] ARISTANDCA 10537469-ARISTANDCA 10537470.
[127] CSI-CLI-00357842 at CSI-CLI-00357849 (emphasis added).
[128] Ullal Dep. (ITC) Tr. at 58:1–12, 61:22–25.
[129] *See, e.g.*, http://www.arista.com/blogs/?p=1301; http://www.arista.com/blogs/?p=1169; http://www.arista.com/blogs/?p=1096

140.   In my opening report and in this report (*supra*), I have explained in great detail

that it is my opinion that Cisco's copyrighted works are the subject of substantial creativity and

expression; that the Cisco copyrighted works are not "industry standard"; that the Cisco

copyrighted works are not required for interoperability or for interacting with routers or switches

from different vendors; and that Cisco has always maintained that its copyrighted works are

proprietary. Accordingly, I incorporate all of those opinions here by reference as they relate to

the "nature of the copyrighted work" factor.

C.   "The amount and substantiality of the portion used in relation to the copyrighted work as a whole"

141.   I have been informed that the analysis under this factor can take into account both

qualitative and quantitative copying. I further understand and have been informed that copying

key expressions from a work, *e.g.*, those that may be the "heart and soul" of a work, is a

consideration as well even if the quantitative amount may not be large. I further understand that

individual elements or components of registered copyrights can constitute, for purposes of fair

use, their own works.

142.   In my opinion, Arista has copied a substantial portion of the copyrighted works at

issue in this case, both quantitatively and qualitatively. Arista has made a number of statements

that confirm my opinions. For example, Arista's CEO has specifically and publicly

acknowledged substantial copying since Arista has cloned the "look and feel" of the copyrighted

works: "[A] Cisco CCIE expert would be able to use Arista right away, because we have a

similar command-line interface and operational look and feel. Where we don't have to invent,

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we don't."[130] Arista's co-founder and current Chief Technology Officer Kenneth Duda likewise

stated that Arista aimed to "[p]rovide familiar interfaces to ease adoption" including a "standard

CLI that … retains familiar management commands" so much so that "80% [of Arista

customers] tell us they appreciate the way they can leverage their deep [Cisco] IOS experience,

as they can easily upgrade an aging [Cisco] Catalyst infrastructure to Arista."[131] Mr. Duda has

further confirmed that a substantial amount of Cisco's copyrighted works were intentionally

copied by Arista: "Familiar management interfaces, standard CLI … It's been very helpful for

our customers to be able to rapidly adopt our products and integrate them into their environments

… that our switches provide a familiar management interface so their existing tools and

processes, screen scraping, automation, continue to work just as they did before."[132] In fact,

when asked "[i]f [customers] just want to take the [Arista] switch, just as they're used to, take it

out of the box, plug in your console, whatever, SSH in, it's no different," Mr. Duda answered in

the affirmative—"Yeah."[133] And when Arista executive Anshul Sadana was asked at his

deposition if he told customers that Arista's CLI was just like Cisco's CLI, he ultimately

confirmed that he did make those statements[134]:

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[130] *See, e.g.*, John Gallant, "How Arista Networks Got Out In Front of the SDN Craze," Network World (Feb. 22, 2013).

[131] *See, e.g.*, Posting of Kenneth Duda to Arista EOS Central, "Linux as a Switch Operating System: Five Lessons Learned" (Nov. 5, 2013), *available at* https://eos.arista.com/linux-as-a-switchoperating-system-five-lessons-learned/.

[132] *See, e.g.*, Arista, *EOS Bits & Bytes - Episode 1 - Lessons Learned While Building a Network OS on Top of Linux*, Arista EOS Central - Video Library (Jan. 30, 2014), at 6:55–7:56, *available at* http://eos.arista.com/wp-content/themes/aristaeos/video-lightbox.php?vid=ttp6lavHKGo.

[133] *See, e.g.*, Arista, *EOS Bits & Bytes - Episode 1 - Lessons Learned While Building a Network OS on Top of Linux*, Arista EOS Central - Video Library (Jan. 30, 2014), at 8:12–22, *available at* http://eos.arista.com/wp-content/themes/aristaeos/videolightbox. php?vid=ttp6lavHKGo*; see, e.g.*, Arista, *EOS: An Extensible Operating System* ("[t]he familiar EOS command-line interface (CLI) avoids retraining costs.").

[134] Anshul Sadana Deposition Tr. at 236:4-14.

4 Q. Are you denying, sir, that you told Arista
5 customers that your CLI is just like Cisco's CLI?
6 A. That's not what you asked.
7 Q. I'm asking you that question right now.
8 Are you denying, sir, that you told Arista
9 customers that your CLI is just like Cisco's CLI?
10 A. I'm not denying that.
11 Q. You said that, correct?
12 A. No. Yeah, I said that.
13 Q. Yeah?
14 A. Yeah.

143.   Additional Arista statements confirm that copying has been substantial because

the entirely of Cisco's IOS CLI was copied:

[redacted]

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[135]   ARISTANDCA10499890 at ARISTANDCA10499893.
[136]   ARISTANDCA 12060827.
[137]   ANI-ITC-944_945-3599339.
[138]   *Id.* at ARISTANDCA10499891.
[139]   *Id.* at ARISTANDCA10499890.
[140]   ARISTANDCA10499890.
[141]   ARISTANDCA 10537469-ARISTANDCA 10537470.

145.   In sum, by copying the "look and feel" of Cisco's IOS CLI, Arista copied a qualitatively significant portion of the works at issue—indeed, as I stated earlier, a user sitting in front of an Arista CLI would have a hard time knowing that they were not actually using a Cisco CLI. The interface, displays, command expressions, and help descriptions are identical or very similar, which gives the user the entire "look and feel" of Cisco's IOS CLI.

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142   ANI-ITC-944_945-3452526.

[143] Almeroth Opening Report Para. 97.

[144] Almeroth Opening Report Paras. 135-154; *e.g.*, Arista Networks EOS User Manual Version 4.4.0 (CSI-CLI-00007473), Arista Networks EOS User Manual Version 4.0.1 (CSI-CLI-00007244), Arista Networks EOS User Manual Version 4.6.2 (CSI-CLI-00006858), Arista Networks EOS User Manual Version 4.10.0 (CSI-CLI-00007841), Arista Networks EOS User Manual Version 4.11.1 - Rev. 2 (CSI-CLI-00010517), Arista Networks EOS User Manual Version 4.11.2.1 (CSI-CLI-00008985), Arista Networks EOS User Manual Version 4.12.4 (CSI-CLI-00014141), Arista Networks EOS User Manual Version 4.13.7M (CSI-CLI-00011973), Arista Networks EOS User Manual Version 4.14.3F - Rev. 2 (CSI-CLI-00018146), Arista Networks EOS User Manual Version 4.14.5F Rev. 2 (CSI-CLI-00000084), Arista Networks EOS User Manual Version 4.14.6M (CSI-CLI-00004616), Arista Networks EOS User Manual Version 4.15.OF - Rev. 2.27 (CSI-CLI-00020575), Arista Networks EOS User Manual Version 4.15.0F (CSI-CLI-00002332), Arista Networks EOS User Manual Version 4.13.6F (CSI-CLI-00016001).

[145] Almeroth Opening Report Para. 160-167.

[146] ARISTANDCA1199299.

148.   Although I believe that the quantitative aspect of Arista's copying is far more

significant here because Arista has taken the heart and soul of Cisco's copyrighted works, I have

nevertheless attempted to quantify the examples of Arista's copying that I have found. Because

these are examples, in my opinion they are conservative estimates of the scope of Arista's

copying. From a quantitative perspective:

        a.   Arista copied at least 579 command help screens across IOS and IOS-XR,

as shown in Exhibit-6. This is a conservative estimate as it does not include NX-OS, and

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147   ANI-ITC-944_945-3473603.
148   ARISTANDCA11996066
149   CSI-CLI-00357842 at CSI-CLI-00357849; Ullal Dep. (ITC) Tr. at 58:1–12, 61:22–
25.
150   CSI-CLI-00357842 at CSI-CLI-00357849 (emphasis added).
151   Ullal Dep. (ITC) Tr. at 58:1–12, 61:22–25.
152   Almeroth Copying Exhibit-1, and Exhibit -3.

I have attempted to remove duplicates and non-multi-word outputs. Furthermore, not all

of these are identical matches; for those that are not identical, they are at least within a

75% hit range on a per command help description basis, which in my opinion shows

copying as well. Furthermore, these are significant because they are not only evidence

that Arista copied output displays but that Arista incorporated them into its source code,

which rebuts Arista's claim (and its experts' claims) that Arista wrote all of its EOS

source code from scratch. Lastly, the 579 total does not account for the examples I

provided in my report starting at Paragraph 127 that are not listed in Exhibit-6, which

account for roughly 30 additional examples, which brings the total to 609.

        b.   With respect to output displays, Exhibit-3 to my opening report lists 37

different examples of copied outputs, and I also included the copied "help screen" in my

opening report, which raises the total of exemplary output displays copied to 38.

However, I note that these displays were copied into 11 different Arista user manuals[153]

and from 18 unique Cisco documents over time.[154] So, in total, there are 324 instances of

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[153]   Arista User Manual v. 4.10.0 (7/19/2012); Arista User Manual v. 4.11.1 – Rev 2 (1/22/2013); Arista User Manual v. 4.11.2.1 (3/1/2013); Arista User Manual v. 4.12.4 (9/16/2013); Arista User Manual v. 4.13.6F (4/14/2014); Arista User Manual v. 4.13.7M (6/17/2014); Arista User Manual v. 4.14.3F – Rev. 2 (10/2/2014); Arista User Manual v. 4.14.5F – Rev. 2 (12/22/2014); Arista User Manual v. 4.14.6M (1/19/2015); Arista User Manual v. 4.15.0F (4/18/2015); Arista User Manual v. 4.15.0F – Rev. 2 (4/27/2015).

[154]   Cisco Configuration Fundamentals Configuration Guide, Cisco IOS Release 15M&T (2013); Cisco IOS Asynchronous Transfer Mode Command Reference (2011); Cisco IOS Asynchronous Transfer Mode Command Reference (2013); Cisco IOS Interfaces and Hardware Component Command Reference (2013); Cisco IOS IP Addressing Services Command Reference at 22 (2011); Cisco IOS IP Routing Protocols Command Reference, Release 12.4 (2005), at IP2R-553; Cisco IOS IP Routing:OSPF Command Reference (2013); Cisco IOS Multicast Command Reference at 625 (2013); Cisco IOS Security Command Reference Commands S to Z (July 2011); Cisco IOS SNMP Support Command Reference (2011); Cisco IOS SNMP Support Command Reference (2013); Cisco Nexus 7000 Series NX-OS Interfaces Command Reference (August 2013); Cisco Nexus 7000 Series NX-OS Multicast Routing Command Reference (August 2013); Cisco Nexus 7000 Series NX-OS Multicast Routing

Arista copying these 37 outputs into its documents in addition to copying them into EOS itself. I also note that I provided additional examples of similar outputs in my opening report that Arista created for a sale presentation.[155] These examples further confirm the large amount of copying.

c. With respect to the copying of Cisco's technical documents (excluding the outputs discussed previously), Exhibit-1 to my opening report shows roughly 531 copying examples from 107 unique Cisco documents. In total, Exhibit-1 shows 2522 instances of Arista copying Cisco's technical documents.

d. Arista copied 8 out of 8 modes in 15 different versions of EOS, as shown in Exhibit-4 to my opening report.

e. Arista copied 8 out of 8 prompts in 15 different versions of EOS, as shown in Exhibit-4 to my opening report.

f. Arista copied 11 command expression hierarchies across 15 different versions of EOS, as shown in Exhibit-5 to my opening report.

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Configuration Guide (2012); Cisco Nexus 7000 Series NX-OS Security Command Reference (August 2013), at SEC-661; Cisco Nexus 7000 Series NX-OS System Management Command Reference (August 2013); Cisco Nexus 7000 Series NX-OS System Management Command Reference, Release 5.x (April 2010); Cisco Nexus 7000 Series NX-OS Unicast Routing Command Reference (August 2013).

[155]   Almeroth Opening Report Para 219 (citing ARISTANDCA1224429).

[156] ARISTANDCA10113782-83, at 82 (Dale Deposition, at Exhibit 112) (emphasis added). *See also*, CSI-CLI-01715053-108, at 090 (Dale Deposition, at Exhibit 106). CSI-CLI-01715053-108, at 090 (Dale Deposition, at Exhibit 106).

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150.   Industry analysts have confirmed my opinions as well. An article published in CRN in 2014 stated: "[Arista] created a CLI [command-line interface] that <u>looks and acts very much like Cisco's</u> …there are a lot of folks out there that are proficient with the Cisco command-line and user interface. Arista is a real natural fit for them."[163] Another third-party commented

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[157] ANI-ITC-944_945-3473603 (Sadana Deposition, at Exhibit 365) (emphasis added). In 2010, Arista created its own versions of certain documentation.

[158] ARISTANDCA12228912-28, at 21 (emphasis added).

[159] ARISTANDCA12228912-28, at 22 (emphasis added).

[160] ARISTANDCA12228912-28, at 27 (emphasis added). *See also*, ARISTANDCA13009582-610, at 588.

[161] *See* ARISTANDCA13616527-58, at 50 (emphasis added). *See also*, ARISTANDCA13664355-85, at 79; ARISTANDCA13660035-81, at 52; ARISTANDCA13616311-60, at 36; ARISTANDCA13626648-97, at 65; ARISTANDCA13640583-721, at 594; ARISTANDCA13683317-94, at 73.

[162] ARISTANDCA12260617 (emphasis added).

[163] http://www.crn.com/print/news/networking/300073307/ arista-partners-our-business-is-booming-as-competition-with-cisco-heats-up.htm?page=0%2C1 (viewed 5/18/2016) (emphasis added).

on the similarity between the two CLIs as follows: "Arista provides a CISCO like CLI, when I say 'CISCO like' I mean it's 95% the same commands..."[164]

151.   IOS and its documents comprise a compilation of many different groupings of creative expressions (not unlike an encyclopedia), some of which have no bearing on this case. Indeed, each IOS version has numerous "books" (as Cisco refers to them from time to time) that address different groups of commands and related outputs.   For example, Cisco has documents for mobile devices, embedded technology, and networking (among many others).[165] Thus, from a technical perspective it would be misleading and incorrect to assume that every document in the compilation of "registered" works would be relevant to the analysis of what Cisco alleges to have been copied here. What is relevant are the works related to Ethernet switches/routers. And in my professional opinion as a computer scientist and engineer, other engineers and computer scientists would know the difference between what is relevant to Ethernet switch/router technology and what is not.

152.   With this background in mind, it is my opinion that Ms. Elsten's conclusion that only 5% of Cisco's IOS commands were copied is incorrect.[166] Ms. Elsten did not account for the fact that IOS is a multi-faceted operating system and thus includes groups or "books" of command expressions that are irrelevant to the Ethernet switches/routers at issue here (let alone account for copying of other covered elements such as documents, displays, modes, prompts, etc., which she does not address at all). As a result, her calculation includes an inflated denominator, which results in a percentage of command expression copying that is much lower

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[164] https://cybermashup.com/2014/01/20/first-steps-with-arista-networks/ (viewed 5/27/2016) (emphasis added).

[165] *See, e.g.*, CSI-CLI-00084839 (IP Mobility: Mobile Networks Configuration Guide, Cisco IOS Release 15M&T); CSI-CLI-00085923 (MPLS: Embedded Management and MIBs Configuration Guide, Cisco IOS Release 15M&T).

[166]   Elsten at 19-20.

than it would be if she performed a calculation directed to Ethernet switch/router command

expressions only.

153.   Further, it also is my opinion that Ms. Elsten's conclusion that only 5% of EOS is

comprised of command expressions that Arista copied from Cisco is incorrect.[167] I have

analyzed Arista's user manuals for all versions of EOS at issue, and what I have found is that

there is substantially more overlap than that—in some cases 100x more. What my analysis

shows is that up to 67% of earlier versions of Arista EOS were comprised of commands copied

from Cisco and that, as Arista added more commands overtime, that percentage gradually

decreased to 37.6%:

EOS Versions	Number of Copied Commands	Total Commands in EOS Manual	Total Command % Between Second And Third Columns
4.0.1	101/509	189	53.4%
4.4.0	167/509	308	54.2%
4.6.2	126/509	188	67.0%
4.10.0	353/509	674	52.4%
4.11.1.2	431/509	853	50.5%
4.11.2.1	445/509	890	50.0%
4.12.4	472/509	1084	43.5%
4.13.6F	508/509	1263	40.2%
4.13.7M	508/509	1281	39.7%
4.14.3F	508/509	1327	38.3%
4.14.5F	507/509	1341	37.8%
4.14.6M	507/509	1339	37.9%
4.15.0F	456/509	1368	33.3%
4.15.3F	508/509	1352	37.6%

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[167] Elsten at 19-20.

155.   In my opinion, the analysis that I performed is more sound than Ms. Elsten's because it is based on analyzing the manuals that Arista provides to its customers in order to teach them how use Arista's EOS. And, as a result, it is reasonable to assume that Arista has included the most relevant command expressions in the user manuals so that its customer can utilize its products in a manner that Arista intended. Accordingly, analyzing the command expressions copied into Arista's manuals captures a better picture of just how substantial Arista's copying of Cisco's command expressions has been over time.

D.   "The effect of the use upon the potential market for or value of the copyrighted work"

156.   I understand that the inquiry under the fourth fair use factor includes harm to the original and derivative works and the effect on the potential market if the challenged use becomes widespread.

157.   In my opinion, Arista's use of Cisco's copyrighted works impacts actual and potential markets because, as I stated above and in my opening report, I understand that Arista directly competes with Cisco for sales of products (switches and routers) that incorporate and use Cisco's copyrighted works. As the evidence I have seen shows, Arista copied Cisco's copyrighted works in order to reduce its own costs and compete with Cisco and replace Cisco in

the market in an "[un]conventional way."[169] For example, Arista's CEO stated: "Since I helped

build the enterprise, I would never compete with Cisco directly in the enterprise in a

conventional way. It makes no sense. It would take me 15 years and 15,000 engineers, and that's

not a recipe for success."[170] As a result of this strategy, Arista is now, according to its CEO, a

fierce competitor with Cisco.[171] Additionally, Arista has explained that its use of Cisco's

copyrighted works was targeted at winning customers from Cisco—as Arista can market its

products as an easily implemented alternative to Cisco products for Cisco's existing

customers.[172]

158.   As I have stated previously, Cisco's copyrighted works are, from a technical

perspective, important to Cisco's products. Cisco's copyrighted works allow the switches and

routers to work, teach customers how to use those products, and allow customers to interact with

the products. And, with respect to the IOS CLI that is part of the copyrighted works, Arista has

copied the entire "look and feel" of that element, which from a technical perspective is the core

of the IOS operating system experience—it is the element by which users interact and recognize

Cisco's IOS, and as a result they are going to be most familiar with it. As I stated above,

Arista's cloning of Cisco's copyrighted works has been so robotic that, in my opinion, a network

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[169] Almeroth Opening Report Paras. 70, 147-148.

[170] *See, e.g.*, Adam Lashinsky, "An Ex-Cisco Exec Reflects," Fortune (Mar. 20, 2014), *available at* http://fortune.com/2014/03/20/an-exciscoexec- reflects/.

[171] Almeroth Opening Report Para. 69; CSI-CLl-00357842 at CSI-CLI-00357851

[172] Almeroth Opening Expert Report Para. 257. *See, e.g.* Sadana Deposition Tr. at 236:4-17, ARISTANDCA11996066, ARISTANDCA104437, ARISTANDCA1206372, ANI-ITC-944_945-3473603, ARISTANDCA1199299, ANI-ITC-944_945-3927203, ARISTANDCA10499890, ARISTANDCA_SW_105998, CSI-ANI-00381280, ARISTANDCA11411864, ARISTANDCA10499890, ANI-ITC-944_945-3452525, ARISTANDCA1194925, CSI-CLI-00540078, Packet Pushers Clip (Audio File) (Duda Exh. 274), Sadana Deposition, Exhibit 382, at 78, Posting of Kenneth Duda to Arista EOS Central, "Linux as a Switch Operating System: Five Lessons Learned" (Nov. 5, 2013), available athttps://eos.arista.com/linux-as-a-switch-operating-system-five-lessons-learned/.

engineer operating an Arista device would have a hard time knowing that he or she is not using a

Cisco IOS product. That was apparent to me from the testing that I performed on both Cisco and

Arista switches, as I set forth in my opening report. As a result, in my opinion Cisco is forced to

compete with its own technology in the marketplace.

159.   Further, as I stated in my opening report and above, I understand that Arista

provides products, software, and technical support incorporating Cisco's copyrights to its

distributors and/or customers so that they use Arista's EOS and its CLI.[173] Arista thus knows

that its distributors and customers purchase its products to use, reproduce, distribute, and/or

publicly display computer programs and/or other works that incorporate Cisco's copyrights,

including by use of Cisco's IOS CLI—Arista has publicly admitted that at least 80% of its

customers consider this infringing functionality to be an important factor in their decisions to

purchase Arista's products.[174] In my opinion, it is logical to conclude that Arista has knowledge

that its acts contribute to and encourage its distributors' and customers' copying of Cisco's

copyrights as well in order to drive competition with Cisco.

161.   In addition to the foregoing, I understand that this fair use factor considers what

would happen to Cisco's market if anyone were able to make the same use that Arista has made

and such use became widespread. In light of the foregoing impacts from Arista's use alone, it is

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[173] Almeroth Opening Report Para. 154.
[174] CSI-CLI-00540078 at CSI-CLI-00540079
[175] Almeroth Opening Report Paras. 149-151.
[176] Almeroth Opening Report Paras. 149-151.

clear that widespread use of this nature would further impact Cisco's ability to compete in the market—with more IOS clones in the marketplace, it becomes harder for Cisco to leverage the innovation and investment in its copyrighted works for itself. And as I stated above, I have yet to see any evidence of any widespread copying of Cisco's copyrighted works that comes close to what Arista has done.

VIII.   NETWORK ORCHESTRATION PRODUCTS & TAIL-F

162.   Arista's expert also provided comments and opinions relating to certain network orchestration products and other products (*e.g.*, ConfD) that are not at issue in this case. Although it is unclear why Arista's experts have provided descriptions and analysis of these products, I have nevertheless analyzed those products, the relevant witness testimony, and Arista's expert opinions regarding those products. I also have spoken with Cisco engineers regarding the marketing, operation, and functionality of the products. In sum, none of Arista's expert opinions nor the evidence I have reviewed change my opinion that Arista has copied Cisco's copyrighted works, and I have seen no suggestion from any Arista expert that their analysis of these products is at all relevant to the determination of what Arista copied Cisco.

163.   By way of example, Arista's experts have said the following about certain network orchestration products and/or other ancillary products not at issue in this case:

Seifert:

> "Cisco has acquired or developed products that utilize the commands, keywords, and data structures of other vendors' CLIs. …For those market segments, Cisco's products must seamlessly integrate with other vendors' products to satisfy their customers. Integrating other vendors' CLI commands, keywords, etc., into its products has become a business imperative for Cisco."[177]

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[177]   Seifert Para. 12.

"The NSO software issues commands and configuration information to each network device through its CLI. In other words, a Cisco software product contains all of the commands, keywords, and data structures for other vendors' CLI to permit service orchestration and delivery.[178]

Elsten:

"The NCS/NSO software allows companies to easily implement network solutions across a variety of networking devices and multiple vendors using a variety of CLI styles (including Cisco-style and Juniper-style)."[179]

The ConfD product appears to be a slimmed down version of NCS/NSO that customers use with switches from Cisco's competitors (network device manufacturers). Similar to NCS/NSO, this software allows customers to use either a Cisco-like or Juniper-like CLI."[180]

"Cisco's offer and sale of a product that allows its competitors' customers to use Cisco or "Cisco-like" CLIs to configure and communicate with non-Cisco switches appears to be perpetuating widespread use of its CLI commands on non-Cisco switches, which utilize non-IOS operating systems. The logical conclusion is that Cisco either recognizes that the use of its CLI commands on non-Cisco switches does not harm the market for its copyrighted work, or it is itself abetting that harm."[181]

Black:

"[T]wo Cisco products--the NSO product and the ConfD product—use third-party vendor CLI commands, hierarchies, modes, prompts, and responses to provide functionality to customers. The Cisco NSO product features NEDs that use third-party vendor CLIs to directly communicate with non-Cisco networking devices (including Arista, Juniper, Huawei, and other vendor switches), and also emulates a Cisco-style CLI (*e.g.*, IOS-XR CLI) and a Juniper-style CLI (*e.g.*, JUNOS CLI) that is displayed to the end-user customer. In other words, a user of the Cisco NSO product can, if they prefer, interact with the product as if he or she were interacting directly with a Juniper JUNOS product, using the Juniper JUNOS CLI commands, hierarchies, modes, prompts, and responses. The Cisco ConfD product is similar in that it enables network device manufacturers to add a Juniper

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[178]   Seifert Paras. 81-83.
[179]   Elsten at 33.
[180]   Elsten at 33.   I disagree with Ms. Elsten. ConfD and NCS/NSO are vastly different products from one another, and from an technical perspective it would wrong to say that ConfD is simply a slimmed down version of NCS/NSO. Conversation with Carl Moberg and Johan Bevemyr (June 13, 2016); Deposition of Bevemyr; Deposition of Moberg.
[181]   Elsten at 33.

JUNOS-style CLI to their devices, or a Cisco IOS or IOS-XR-style CLI to their devices, thereby making their devices appear to end-user customers as supporting the Juniper JUNOS CLI commands, hierarchies, modes, prompts, and responses, or Cisco IOS or IOS-XR CLI commands, hierarchies, modes, prompts, and responses."[182]

"The Cisco NSO NEDs are capable of providing fine-grained representations of relevant configuration commands for each supported networking device using the CLI command syntax, and command modes, supported by each particular device."[183]

"[T]he Cisco NSO NEDs are designed to use, and in fact use, the CLI commands, modes, and hierarchies supported by third-party networking devices, including Arista, Brocade, Dell, and Huawei networking devices, to communicate with those third-party devices for configuration and provisioning purposes."[184]

"Tail-F sold its NCS product with a feature that provided end users of the product with the option of interacting with a CLI that is intended to mimic the Cisco IOS-XR CLI in terms of command modes, prompts, commands, command modes, and command hierarchies. It is up to the end-user customer to determine whether he or she wishes to use Juniper JUNOS-style CLI (and its associated commands, hierarchies, modes, prompts, and responses) or a Cisco IOS-XR CLI (and its associated commands, hierarchies, modes, prompts, and responses) on the Cisco NSO product."[185]

"The CiscoWorks NCM product detects the different vendor devices and models in the network using "standard show commands," which are common show commands that the NCM product issues to ascertain the make and model of each network element."[186]

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[182]   Black Para. 471.
[183]   Black Para. 454.
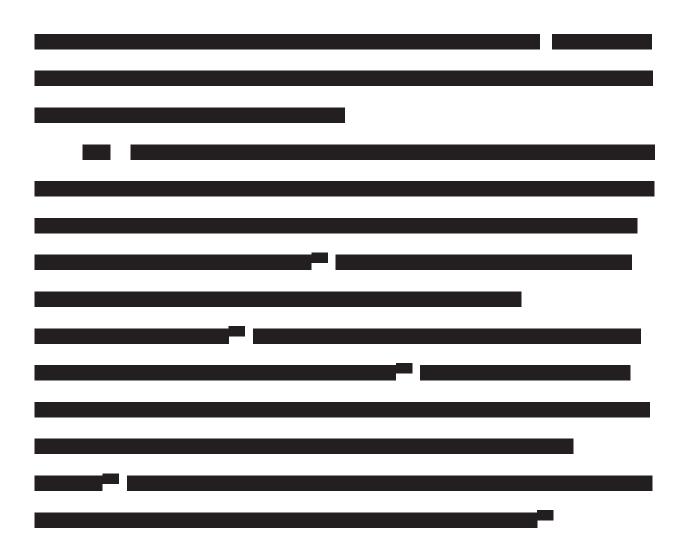[184]   Black Para. 456.
[185]   Black Para 462.
[186]   Black Para 479.
[187]   In support of my opinions about NCM, I have reviewed the depositions transcripts and exhibits from the depositions of Beecher Adams (Cisco's corporate representative) and HP's corporate representative and rely on those depositions and exhibits in my discussion below.

[188]   Moberg Dep. Tr. at 39:2-11 ("Q. Well, we will break that down into two questions; what is the purpose of the Cisco NSO product for Cisco? MR HOLMES: Objection, vague. A. The purpose from a product management perspective is to have a useful offering in the network service orchestration, I guess the network service orchestration market, so it is a – complementary to many other offerings from Cisco."); Moberg Dep. Tr. at 176:45-177:5 ("Q. Would you consider NCS to be a product that is complementary to switchers and routers? MR WONG: Objection, vague. A. NCS is definitely complementary to routers and switchers, yes. That is its value proposition."); Venkatraman (HP) Dep. Tr. at 112:8-113:13 ("Q Now, you discussed earlier with counsel a product called Network Automation product. Do you remember that? A   Yes. Q   And that's an HP product? A   Correct. Q. And the analogous product, I believe, that is -- that HP OEMs for Cisco is the Cisco Network Compliance Manager; is that right? A. Correct. Q. Now, the HP Network Automation product, that's not a router, is it? A No. Q. And it's not a switch, correct? A.   No. Q   And I believe your testimony is that the Network Automation product, in fact, supports various network elements, right? A. Yes. Q. And so it's fair to say that the Network Automation product is complementary to a router or a switch, correct? A. The Network Automation product is a software product that helps manage the configuration -- changes to the configuration and compliance across multiple vendors. Q. Would it be fair to say that the Network Automation product does not specifically compete in the marketplace with a switch or a router? A. That is correct. We -- the switch and the router is not competitive to Network Automation.").

[189]   Conversation with Carl Moberg and Johan Bevemyr (June 13, 2016).

[190]   Conversation with Carl Moberg and Johan Bevemyr (June 13, 2016).

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191 *E.g.*, Black Para. 456; Seifert Para. 12, 81-82; Elsten at 33.

192 Conversation with Carl Moberg and Johan Bevemyr (June 13, 2016); *see generally* Deposition of Bevemyr, *e.g.*, Tr. at 37-38 ("But as soon as you go into any specifics, it would differ."; "the vast majority of commands would, again, depend on which data model you are feeding into the device or NCS").

193 Conversation with Carl Moberg and Johan Bevemyr (June 13, 2016).

194 Conversation with Carl Moberg and Johan Bevemyr (June 13, 2016); Deposition of Bevemyr Tr. at 18:6-15 ("So it depends on what the customer feeds into the system in terms of YANG files, what kind of CLI will be presented. So there is some basic scaffolding in the -- in the CLI. So if you start ConfD with just -- without data models, you would have almost no commands available. And then the customer feeds in his data model and that will create a larger CLI, if you want. It will create the possibility to set the configuration parameters.").

195 Conversation with Carl Moberg and Johan Bevemyr (June 13, 2016); Deposition of Bevemyr Tr. at 22:

[REDACTED]

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[196]   Black Para. 170.

[197]   Conversation with Carl Moberg and Johan Bevemyr (June 13, 2016).

[198]   Conversation with Carl Moberg and Johan Bevemyr (June 13, 2016); Deposition of Bevemyr Tr. at 21-23 (explaining the difficultly in mapping on a command-based CLI, that "the banner command" was not supported by ConfD, that there were "significant differences" between ConfD's Juniper "style" of CLI and the actual Juniper CLI, and that at least one customer looked at ConfD and "decided not to use it because it wasn't close enough to – to Juniper CLI"); *id.* at 23:3-9 ("we didn't have access to a Juniper box so there were deviations that were – well, we – we – we didn't know what Juniper box looked like, and we weren't particularly trying to copy it either").

[199]   Conversation with Carl Moberg and Johan Bevemyr (June 13, 2016).

[200]   Conversation with Carl Moberg and Johan Bevemyr (June 13, 2016).

[201]   Conversation with Carl Moberg and Johan Bevemyr (June 13, 2016); *see* Deposition of Bevemyr.

[202]   Conversation with Carl Moberg and Johan Bevemyr (June 13, 2016).

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IX.   ADDITIONAL REBUTTALS

167.   Although Dr. Black does not explain why it is relevant, Dr. Black provides

analysis of various vendor's purported use of certain command expressions in the 2003-2004

timeframe.[203] Dr. Black's attempt to "re-create" history is difficult to assess because he has not

inspected any of the vendor products that he discusses, and I am not aware of any such products

being made available during discovery by Arista or any third party. Thus the reliability of his

analysis is not entirely verifiable. Nevertheless, to the extent that Dr. Black's point is that others

in the industry may have been using command expressions that are similar to the ones at issue in

this case, I have seen no evidence to suggest that those vendors were infringing Cisco's

copyrighted works. Nor has there been any allegation of infringement by Cisco let alone any

evidence to suggest that Cisco was aware of any such infringement. Furthermore, as I stated

above, Dr. Black's survey of various vendors' use of multi-word commands (if true) show that

there has not been widespread use of those commands with any consistency in the industry, and

Arista is far and away an outlier in terms of copying (other than Huawei). And that does not

even take into account Arista's copying of other works, such as Cisco's documentation, display

outputs, and command help screens, about which Dr. Black provides no information. His

analysis is therefore incomplete to the extent he is attempt to draw an analogy between other

vendors' actions and Arista's.

168.   Furthermore, as Cisco pointed out in its interrogatory responses, Arista and

Huawei are the only two companies Cisco is/was aware of that were infringing Cisco's

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[203]   *E.g.*, Black Paras. 193, 434-437.

copyrighted works.[204]   Cisco determined that Arista had engaged in deliberate and widespread

copying of Cisco's copyrighted a few months before it sued Arista, that and it learned of

Huawei's use of Cisco's copyrighted works no later than the time that the original complaint in

that case was filed.[205]   I also understand that Cisco was not aware of public information that

other companies (setting aside the litigation with Huawei) engaged in the same type of "slavish"

copying of CLI commands, modes, hierarchies, prompts, display outputs, and command help

screens as Arista.[206]

169.   I also disagree with Dr. Black's conclusion that the modes and prompts are

unoriginal.[207]   I have reviewed Mr. Lougheed's testimony and related materials and do not agree

that he admits that Cisco copied any of the modes and prompts at issue in this case from TOPS-

20 and UNIX legacy systems, even if there may have been an awareness that those systems used

certain prompts and modes.[208]

X.   CONCLUSION

170.   For presentation of my testimony at trial I may create and use demonstratives,

videos, and/or additional screenshots of the copyrighted works described in this report. In

addition, I may demonstrate the use of one or more Arista and Cisco switches at trial in support

of my testimony.

171.   I reserve the right to supplement or amend my opinions in response to opinions

expressed by Arista's experts, or in light of any additional evidence, testimony, discovery or

other information that may be provided to me after the date of this report. In addition, I reserve

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[204]   Cisco's Response to Interrogatory No. 22.
[205]   Cisco's Response to Interrogatory No. 22.
[206]   Cisco's Response to Interrogatory No. 22.
[207]   Black Para 636.
[208]   *See generally* Deposition Testimony of Kirk Lougheed.

the right to consider and testify about issues that may be raised by Arista's fact witnesses and experts at trial. I also reserve the right to modify or to supplement my opinions as a result of ongoing expert discovery or testimony at trial.

I certify under penalty of perjury that the foregoing is true and correct.

By:_____

Dr. Kevin C. Almeroth
June 17, 2016

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Education

Ph.D.   June 1997 *Georgia Institute of Technology*   Computer Science

Dissertation Title: Networking and System Support for the Efficient, Scalable Delivery of Services in Interactive Multimedia Systems

Minor: Telecommunications Public Policy

M.S.   June 1994 *Georgia Institute of Technology*   Computer Science

Specialization: Networking and Systems

B.S.   June 1992 *Georgia Institute of Technology*   Information and Computer Science
(high honors)   *Minors*: Economics, Technical Communication, American Literature

Employment History

Professor	Department of Computer Science University of California Santa Barbara, CA	Jul 2005 -- present
Associate Dean	College of Engineering University of California Santa Barbara, CA	Mar 2007 -- Aug 2009
Vice Chair	Department of Computer Science University of California Santa Barbara, CA	Jul 2000 -- Nov 2005
Associate Professor	Department of Computer Science University of California Santa Barbara, CA	Jul 2001 -- Jun 2005
Assistant Professor	Department of Computer Science University of California Santa Barbara, CA	Jul 1997 -- Jun 2001

Graduate Researcher	Broadband Telecommunications Center Georgia Center for Adv Telecom Tech Atlanta, GA	Sep 1996--Jun 1997
Graduate Intern	IBM T.J. Watson Research Labs Hawthorne, NY	Jun 1995--Sep 1995
Support Specialist	Office of Information Technology Georgia Institute of Technology Atlanta, GA	Sep 1995--Jun 1997
Research Assistant	College of Computing Georgia Institute of Technology Atlanta, GA	Jan 1994--Mar 1994
Graduate Intern	Hitachi Telecommunications Norcross, GA	Jun 1992--Sep 1992

Industry Technical Advising

Board of Directors	The New Media Studio Santa Barbara, CA	Nov 2006 -- present
Co-Founder & Chairman of the Board	Santa Barbara Labs, LLC Santa Barbara, CA	Sep 2007 -- Dec 2009
Board of Advisors	Techknowledge Point Santa Barbara, CA	May 2001 -- Dec 2007
Technical Advisory Board	Occam Networks, Inc. Santa Barbara, CA	May 2000 -- Dec 2010
Board of Advisors	Airplay Inc. San Francisco, CA	Jun 2005 -- Aug 2009
Consultant	Lockheed Martin Corporation San Jose, CA	Nov 1999 -- Jun 2009
Board of Advisors	Santa Barbara Technology Group Santa Barbara, CA	Sep 2000 -- Dec 2004
Board of Directors	Virtual Bandwidth, Inc. Santa Barbara, CA	Nov 2000 -- Jun 2001
Board of Advisors & Affiliated Scientist	Digital Fountain San Francisco, CA	Jan 2000 -- Dec 2001
Senior Technologist	IP Multicast Initiative, Stardust Forums Campbell, CA	Jun 1998 -- Dec 2000

I. Teaching

A. Courses Taught

CS 176A	Intro to Computer Communication Networks	Fall 1997, Fall 1998, Fall 2002, Fall 2003, Fall 2004, Spring 2005, Spring 2006, Spring 2007, Spring 2008, Fall 2008, Fall 2009, Fall 2010, Fall 2011, Fall 2012, Fall 2013, Fall 2014
CS 176B	Network Computing	Winter 2000, Winter 2001, Winter 2002, Winter 2012, Winter 2014, Winter 2015
MAT 201B	Media Networks and Services	Fall 1999, Fall 2000, Fall 2001, Fall 2003
CS 276	Distributed Computing and Computer Networks	Winter 1999, Spring 2000, Fall 2002, Fall 2005
CS 290I	Networking for Multimedia Systems	Winter 1998, Spring 1999, Fall 2004, Winter 2010
CS 595N	Technology and Society	Winter 2005, Fall 2005, Spring 2006, Fall 2006, Spring 2007, Fall 2007, Spring 2008, Fall 2008, Spring 2009
CS 595N	Economic Systems Seminar	Winter 2004, Spring 2004, Winter 2005, Spring 2005
CS 595N	Networking Seminar	Winter 1999, Fall 1999, Winter 2003
CS 595N	Wireless Networking & Multimedia Seminar	Fall 2000
CS 595I	Systems Design and Implementation Seminar	Fall 1999, Fall 2000, Winter 2001, Spring 2001, Winter 2002, Spring 2002

B. Other Teaching Experience

- *The Evolution of Advanced Networking Services: From the ARPAnet to Internet2*, Instructor, Summer 2001. Short course taught at Escuela de Ciencias Informatica (ECI) sponsored by the Universidad de Buenos Aires.

- *Johns Hopkins Center for Talented Youth*, Instructor, Summer 1994. CTY is a program to teach gifted high school students the fundamentals of computer science.

- *Georgia Institute of Technology*, Graduate Teaching Assistant, Sep 1994--Sep 1996. Worked as a TA for 12 quarters teaching 7 different courses (4 undergraduate and 3 graduate).

C. Ph.D. Students Advised [14 graduated]

14. Daniel Havey
    Research Area: *Throughput and Delay on the Packet Switched Internet*
    Date Graduated: Winter 2015
    First Position: Microsoft
13. Lara Deek (co-advised with E. Belding)
    Research Area: *Resource-Efficient Wireless Systems for Emerging Wireless Networks*
    Date Graduated: Summer 2014
    First Position: Post Doc, UIUC
12. Mike Wittie

Research Area: *Towards Sustained Scalability of Communication Networks*
Date Graduated: Summer 2011
First Position: Assistant Professor, Montana State University

11. Allan Knight

Research Area: *Supporting Integration of Educational Technologies and Research of Their Effects on Learning*
Date Graduated: Summer 2009
First Position: Research Scientist, Citrix Online

10. Hangjin Zhang

Research Area: *Towards Blended Learning: Educational Technology to Improve and Assess Teaching and Learning*
Date Graduated: Spring 2009
First Position: Microsoft

9. Gayatri Swamynathan

Dissertation Title: *Towards Reliable Reputations for Distributed Applications*
Date Graduated: Spring 2008
First Position: Zynga

8. Amit Jardosh (co-advised with E. Belding)

Dissertation Title: *Adaptive Large-Scale Wireles Networks: Measurements, Protocol Designs, and Simulation Studies*
Date Graduated: Fall 2007
First Position: Yahoo!

7. Khaled Harras

Dissertation Title: *Protocol and Architectural Challenges in Delay and Disruption Tolerant Networks*
Date Graduated: Summer 2007
First Position: Assistant Professor, Carnegie Mellon University

6. Krishna Ramachandran (co-advised with E. Belding)

Dissertation Title: *Design, Deployment, and Management of High-Capacity Wireless Mesh Networks*
Date Graduated: Winter 2006
First Position: Research Scientist, Citrix Online

5. Robert Chalmers

Dissertation Title: *Improving Device Mobility with Intelligence at the Network Edge*
Date Graduated: Summer 2004
First Position: President and CEO, Limbo.net

4. Prashant Rajvaidya

Dissertation Title: *Achieving Robust and Secure Deployment of Multicast*
Date Graduated: Spring 2004
First Position: President and CTO, Mosaic Networking

3. Sami Rollins

Dissertation Title: *Overcoming Resource Constraints to Enable Content Exchange Applications in Next-Generation Environments*
Date Graduated: Spring 2003
First Position: Assistant Professor, Mount Holyoke College

2. Srinivasan Jagannathan

Dissertation Title: *Multicast Tree-Based Congestion Control and Topology Management*
Date Graduated: Spring 2003
First Position: Consultant, Kelly & Associates

1. Kamil Sarac

Dissertation Title: *Supporting a Robust Multicast Service in the Global Infrastructure*
Date Graduated: Spring 2002
First Position: Assistant Professor, UT-Dallas

D. M.S. Students Advised (Thesis/Project Option) [19 graduated and 1 current]

20. Greg Parsons
    Research Area: *Drone-Based Mesh Networks*
    Date Started: Fall 2014
19. Neer Shey
    Research Area: *Analyzing Content Distribution Through Opportunistic Contact for Smart Cellular Phones*
    Date Graduated: Spring 2010
18. Camilla Fiorese
    Research Area: *Analysis of a Pure Rate-Based Congestion Control Algorithm*
    Date Graduated: Summer 2009
17. Brian Weiner
    Research Area: *Multi-Socket TCP: A Simple Approach to Improve Performance of Real-Time Applications over TCP*
    Date Graduated: Fall 2007
16. Avijit Sen Mazumder
    Research Area: *Facilitating Robust Multicast Group Management*
    Date Graduated: Fall 2005
15. Rishi Matthew
    Thesis Title: *Providing Seamless Access to Multimedia Content on Heterogeneous Platforms*
    Date Graduated: Summer 2004
14. Camden Ho
    Research Area: *Tools and Techniques for Wireless Network Management*
    Date Graduated: Spring 2004
13. Amit Jardosh (co-advised with E. Belding)
    Research Area: *Realistic Environment Models for Mobile Network Evaluation*
    Date Graduated: Spring 2004
12. Nitin Solanki
    Research Area: *SongWand: A Wireless Barcode Scanner Using Bluetooth Technology*
    Date Graduated: Winter 2004
11. Vrishali Wagle (co-advised with E. Belding)
    Research Area: *An Ontology-Based Service Discovery Mechanism*
    Date Graduated: Winter 2004
10. Uday Mohan
    Thesis Title: *Scalable Service Discovery in Mobile Ad hoc Networks*
    Date Graduated: Spring 2003
9. Krishna Ramachandran
    Thesis Title: *Ubiquitous Multicast*
    Date Graduated: Spring 2003
8. John Slonaker
    Thesis Title: *Inductive Loop Signature Acquisition Techniques*
    Date Graduated: Spring 2002
7. Mohammad Battah
    Thesis Title: *Dedicated Short-Range Communications Intelligent Transportation Systems Protocol (DSRC-ITS)*
    Date Graduated: Spring 2002
6. Kevin Vogel
    Thesis Title: *Integrating E-Commerce Applications into Existing Business Infrastructures*
    Date Graduated: Spring 2001
5. Sami Rollins
    Thesis Title: *Audio XmL: Aural Interaction with XML Documents*
    Date Graduated: Winter 2000
4. Andy Davis

Thesis Title: *Stream Scheduling for Data Servers in a Scalable Interactive TV System*
Date Graduated: Spring 1999

3. David Makofske
Thesis Title: *MHealth: A Real-Time Graphical Multicast Monitoring Tool*
Date Graduated: Winter 1999

2. Prashant Rajvaidya
Thesis Title: *MANTRA: Router-Based Monitoring and Analysis of Multicast Traffic*
Date Graduated: Winter 1999

1. Alex DeCastro (co-advised with Yuan-Fang Wang)
Thesis Title: *Web-Based Collaborative 3D Modeling*
Date Graduated: Winter 1998

E. Teaching Awards

2006-2007 UCSB Academic Senate Distinguished Teaching Award
2004-2005 Computer Science Outstanding Faculty Member
2000-2001 UCSB Spotlight on Excellence Award
1999-2000 Computer Science Outstanding Faculty Member (co-recipient)
1998-1999 Computer Science Outstanding Faculty Member (co-recipient)
1997-1998 Computer Science Outstanding Faculty Member

II. Research

A. Journal Papers, Magazine Articles, Books, and Book Chapters

62. L. Deek, E. Garcia-Villegas, E. Belding, S.J. Lee, and K. Almeroth, "A Practical Framework for 802.11 MIMO Rate Adaptation," Computer Networks, vol. 83, num. 6, pp. 332-348, June 2015.

61. L. Deek, E. Garcia-Villegas, E. Belding, S.J. Lee, and K. Almeroth, "Intelligent Channel Bonding in 802.11n WLANs," IEEE Transactions on Mobile Computing, vol. 13, num. 6, pp. 1242-1255, June 2014.

60. H. Zhang and K. Almeroth, "Alternatives for Monitoring and Limiting Network Access to Students in Network-Connected Classrooms," Journal of Interactive Learning Research (JILR), vol. 24, num. 3, pp. 237-265, July 2013.

59. M. Tavakolifard and K. Almeroth, "A Taxonomy to Express Open Challenges in Trust and Reputation Systems," Journal of Communications, vol. 7, num. 7, pp. 538-551, July 2012.

58. M. Tavakolifard and K. Almeroth, "Social Computing: An Intersection of Recommender Systems, Trust/Reputation Systems, and Social Networks," IEEE Network, vol. 26, num. 4, pp. 53-58, July/August 2012.

57. M. Tavakolifard, K. Almeroth, and P. Ozturk, "Subjectivity Handling of Ratings for Trust and Reputation Systems: An Abductive Reasoning Approach," International Journal of Digital Content Technology and its Applications (JDCTA), vol. 5, num. 11, pp. 359-377, November 2011.

56. R. Raghavendra, P. Acharya, E. Belding and K. Almeroth, "MeshMon: A Multi-Tiered Framework for Wireless Mesh Network Monitoring," Wireless Communications and Mobile Computing (WCMC) Journal, vol. 11, num. 8, pp. 1182-1196, August 2011.

55. A. Knight and K. Almeroth, "Automatic Plagiarism Detection with PAIRwise 2.0," Journal of Interactive Learning Research (JILR), vol. 22, num. 3, pp. 379-400, July 2011.

54. V. Kone, M. Zheleva, M. Wittie, B. Zhao, E. Belding, H. Zheng, and K. Almeroth, "AirLab: Consistency, Fidelity and Privacy in Wireless Measurements," ACM Computer Communications Review, vol. 41, num. 1, pp. 60-65, January 2011.

53. G. Swamynathan, K. Almeroth, and B. Zhao, "The Design of a Reliable Reputation System," Electronic Commerce Research Journal, vol. 10, num. 3-4, pp. 239-270, December 2010.

52. P. Acharya, A. Sharma, E. Belding, K. Almeroth and K. Papagiannaki, "Rate Adaptation in Congested Wireless Networks through Real-Time Measurements," IEEE Transactions on Mobile Computing, vol. 9, num. 11, pp. 1535-1550, November 2010.

51. R. Raghavendra, E. Belding, K. Papagiannaki, and K. Almeroth, "Unwanted Link Layer Traffic in Large IEEE 802.11 Wireless Networks," IEEE Transactions on Mobile Computing, vol. 9, num. 9, pp. 1212-1225, September 2010.

50. H. Zhang and K. Almeroth, "Moodog: Tracking Student Activity in Online Course Management Systems," Journal of Interactive Learning Research (JILR), vol. 21, num. 3, pp. 407-429, July 2010.

49. R. Chertov and K. Almeroth, "Qualitative Comparison of Link Shaping Techniques," International Journal of Communication Networks and Distributed Systems, vol. 5, num. 1/2, pp. 109-129, July 2010.

48. A. Knight and K. Almeroth, "Fast Caption Alignment for Automatic Indexing of Audio," International Journal of Multimedia Data Engineering and Management, vol. 1, num. 2, pp. 1-17, April-June 2010.

47. K. Harras and K. Almeroth, "Scheduling Messengers in Disconnected Clustered Mobile Networks," Ad Hoc & Sensor Wireless Networks, vol. 9, num. 3-4, pp. 275-304, March-April 2010.

46. A. Jardosh, K. Papagiannaki, E. Belding, K. Almeroth, G. Iannaccone, and B. Vinnakota, "Green WLANs: On-Demand WLAN Infrastructures," ACM Journal on Mobile Networks and Applications (MONET), vol. 14, num. 6, pp. 798-814, December 2009.

45. M. Wittie, K. Harras, K. Almeroth, and E. Belding, "On the Implications of Routing Metric Staleness in Delay Tolerant Networks," Computer Communications Special Issue on Delay and Disruption Tolerant Networking, vol. 32, num. 16, pp. 1699-1709, October 2009.

44. K. Harras, L. Deek, C. Holman, and K. Almeroth, "DBS-IC: An Adaptive Data Bundling System for Intermittent Connectivity," Computer Communications Special Issue on Delay and Disruption Tolerant Networking, vol. 32, num. 16, pp. 1687-1698, October 2009.

43. S. Karpinski, E. Belding, K. Almeroth, and J. Gilbert, "Linear Representations of Network Traffic," ACM Journal on Mobile Networks and Applications (MONET), vol. 14, num. 4, pp. 368-386, August 2009.

42. K. Harras and K. Almeroth, "Controlled Flooding in Disconnected Sparse Mobile Networks," Wireless Communications and Mobile Computing (WCMC) Journal, vol. 9, num. 1, pp. 21-33, January 2009.

41. R. Mayer, A. Stull, K. DeLeeuw, K. Almeroth, B. Bimber, D. Chun, M. Bulger, J. Campbell, A. Knight, and H. Zhang, "Clickers in College Classrooms: Fostering Learning with Questioning Methods in Large Lecture Classes," Contemporary Educational Psychology, vol. 34, num. 1, pp. 51-57, January 2009.

40. A. Knight, K. Almeroth, and B. Bimber, "Design, Implementation and Deployment of PAIRwise," Journal of Interactive Learning Research (JILR), vol. 19, num. 3, pp. 489-508, July 2008.

39. A. Garyfalos and K. Almeroth, "Coupons: A Multilevel Incentive Scheme for Information Dissemination in Mobile

Networks," IEEE Transactions on Mobile Computing, vol. 7, num. 6, pp. 792-804, June 2008.

38. I. Sheriff, K. Ramachandran, E. Belding, and K. Almeroth, "A Multi-Radio 802.11 Mesh Network Architecture," ACM Journal on Mobile Networks and Applications (MONET), vol. 13, num. 1-2, pp. 132-146, April 2008.

37. M. Bulger, R. Mayer, K. Almeroth, and S. Blau, "Measuring Learner Engagement in Computer-Equipped College Classrooms," Journal of Educational Multimedia and Hypermedia, vol. 17, num. 2, pp. 129-143, April 2008.

36. G. Swamynathan, B. Zhao, and K. Almeroth, "Exploring the Feasibility of Proactive Reputations," Concurrency and Computation: Practice and Experience, vol. 20, num. 2, pp. 155-166, February 2008.

35. G. Swamynathan, B. Zhao, K. Almeroth, and H. Zheng, "Globally Decoupled Reputations for Large Distributed Networks," Advances in Multimedia, vol. 2007, pp. 1-14, 2007.

34. R. Mayer, A. Stull, J. Campbell, K. Almeroth, B. Bimber, D. Chun and A. Knight, "Overestimation Bias in Self-reported SAT Scores," Educational Psychology Review, vol. 19, num. 4, pp. 443-454, December 2007.

33. P. Namburi, K. Sarac and K. Almeroth, "Practical Utilities for Monitoring Multicast Service Availability," Computer Communications Special Issue on Monitoring and Measurement of IP Networks, vol. 29, num. 10, pp. 1675-1686, June 2006.

32. R. Chalmers, G. Krishnamurthi and K. Almeroth, "Enabling Intelligent Handovers in Heterogeneous Wireless Networks," ACM Journal on Mobile Networks and Applications (MONET), vol. 11, num. 2, pp. 215-227, April 2006.

31. H. Lundgren, K. Ramachandran, E. Belding, K. Almeroth, M. Benny, A. Hewatt, A. Touma and A. Jardosh, "Experience from the Design, Deployment and Usage of the UCSB MeshNet Testbed," IEEE Wireless Communications, vol. 13, num. 2, pp. 18-29, April 2006.

30. R. Mayer, K. Almeroth, B. Bimber, D. Chun, A. Knight and A. Campbell, "Technology Comes to College: Understanding the Cognitive Consequences of Infusing Technology in College Classrooms," Educational Technology, vol. 46, num. 2, pp. 48-53, March-April 2006.

29. A. Garyfalos and K. Almeroth, "A Flexible Overlay Architecture for Mobile IPv6 Multicast," Journal on Selected Areas in Communications (JSAC) Special Issue on Wireless Overlay Networks Based on Mobile IPv6, vol. 23, num. 11, pp. 2194-2205, November 2005.

28. K. Sarac and K. Almeroth, "Monitoring IP Multicast in the Internet: Recent Advances and Ongoing Challenges," IEEE Communications, vol. 43, num. 10, pp. 85-91, October 2005.

27. K. Sarac and K. Almeroth, "Application Layer Reachability Monitoring for IP Multicast," Computer Networks, vol. 48, num. 2, pp. 195-213, June 2005.

26. A. Jardosh, E. Belding, K. Almeroth and S. Suri, "Real-world Environment Models for Mobile Network Evaluation," Journal on Selected Areas in Communications Special Issue on Wireless Ad hoc Networks, vol. 23, num. 3, pp. 622-632, March 2005.

25. S. Rollins and K. Almeroth, "Evaluating Performance Tradeoffs in a One-to-Many Peer Content Distribution Architecture," Journal of Internet Technology, vol. 5, num. 4, pp. 373-387, Fall 2004.

24. K. Sarac and K. Almeroth, "Tracetree: A Scalable Mechanism to Discover Multicast Tree Topologies in the Network," IEEE/ACM Transactions on Networking, vol. 12, num. 5, pp. 795-808, October 2004.

23. K. Sarac and K. Almeroth, "A Distributed Approach for Monitoring Multicast Service Availability," Journal of Network and Systems Management, vol. 12, num. 3, pp. 327-348, September 2004.

22. P. Rajvaidya, K. Ramachandran and K. Almeroth, "Managing and Securing the Global Multicast Infrastructure," Journal of Network and Systems Management, vol. 12, num. 3, pp. 297-326, September 2004.

21. P. Rajvaidya and K. Almeroth, "Multicast Routing Instabilities," IEEE Internet Computing, vol. 8, num. 5, pp. 42-49, September/October 2004.

20. D. Johnson, R. Patton, B. Bimber, K. Almeroth and G. Michaels, "Technology and Plagiarism in the University: Brief Report of a Trial in Detecting Cheating," Association for the Advancement of Computing in Education (AACE) Journal, vol. 12, num. 3, pp. 281-299, Summer 2004.

19. R. Chalmers and K. Almeroth, "A Security Architecture for Mobility-Related Services," Journal of Wireless Personal Communications, vol 29, num. 3, pp. 247-261, June 2004.

18. B. Stiller, K. Almeroth, J. Altmann, L. McKnight, and M. Ott, "Pricing for Content in the Internet," Computer Communications, vol. 27, num. 6, pp. 522-528, April 2004.

17. S. Rollins and K. Almeroth, "Lessons Learned Deploying a Digital Classroom," Journal of Interactive Learning Research (JILR), vol. 15, num. 2, pp. 169-185, April 2004.

16. S. Jagannathan and K. Almeroth, "A Dynamic Pricing Scheme for E-Content at Multiple Levels-of-Service," Computer Communications, vol. 27, num. 4, pp. 374-385, March 2004.

15. K. Almeroth, "Using Satellite Links in the Delivery of Terrestrial Multicast Traffic," Internetworking and Computing over Satellites, Kluwer Academic Publishers, 2003.

14. R. Chalmers and K. Almeroth, "On the Topology of Multicast Trees," IEEE/ACM Transactions on Networking, vol. 11, num. 1, pp. 153-165, January 2003.

13. S. Jagannathan, J. Nayak, K. Almeroth, and M. Hofmann, "On Pricing Algorithms for Batched Content Delivery Systems," Electronic Commerce Research and Applications Journal, vol. 1, num. 3-4, pp. 264-280, Fall 2002.

12. D. Makofske and K. Almeroth, "Multicast Sockets: Practical Guide for Programmers," *Morgan Kaufmann Publishers*, November 2002.

11. S. Jagannathan and K. Almeroth, "Price Issues in Delivering E-Content On-Demand," ACM Sigecom Exchanges, vol. 3, num. 2, pp. 18-27, May 2002.

10. D. Makofske and K. Almeroth, "From Television to Internet Video-on-Demand: Techniques and Tools for VCR-Style Interactivity," Software: Practice and Experience, vol. 31, num. 8, pp. 781-801, July 2001.

9. K. Sarac and K. Almeroth, "Supporting Multicast Deployment Efforts: A Survey of Tools for Multicast Monitoring," Journal on High Speed Networking, Special Issue on Management of Multimedia Networking, vol. 9, num. 3/4, pp. 191-211, March 2001.

8. K. Almeroth, "Adaptive, Workload-Dependent Scheduling for Large-Scale Content Delivery Systems," Transactions on Circuits and Systems for Video Technology, *Special Issue on Streaming Video*, vol. 11, num. 3, pp. 426-439, March 2001.

7. D. Makofske and K. Almeroth, "Real-Time Multicast Tree Visualization and Monitoring," Software: Practice and Experience, vol. 30, num. 9, pp. 1047-1065, July 2000.

6. M. Ammar, K. Almeroth, R. Clark and Z. Fei, "Multicast Delivery of WWW Pages," Electronic Commerce Technology Trends: Challenges and Opportunities, IBM Press, February 2000.

5. K. Almeroth, "The Evolution of Multicast: From the MBone to Inter-Domain Multicast to Internet2 Deployment," IEEE Network Special Issue on Multicasting, vol. 10, num. 1, pp. 10-20, January/February 2000.

4. K. Almeroth and M. Ammar, "An Alternative Paradigm for Scalable On-Demand Applications: Evaluating and Deploying the Interactive Multimedia Jukebox," *IEEE Transactions on Knowledge and Data Engineering Special Issue on Web Technologies*, vol. 11, num. 4, pp 658-672, July/August 1999.

3. K. Almeroth and M. Ammar, "The Interactive Multimedia Jukebox (IMJ): A New Paradigm for the On-Demand Delivery of Audio/Video," *Computer Networks and ISDN Systems*, vol. 30, no. 1, April 1998.

2. K. Almeroth and M. Ammar, "Multicast Group Behavior in the Internet's Multicast Backbone (MBone)," *IEEE Communications*, vol. 35, no. 6, pp. 124-129, June 1997.

1. K. Almeroth and M. Ammar, "On the Use of Multicast Delivery to Provide a Scalable and Interactive Video-on-Demand Service," *Journal on Selected Areas of Communication (JSAC)*, vol. 14, no. 6, pp. 1110-1122, August 1996.

B. Conference Papers with Proceedings (refereed)

89. D. Havey and K. Almeroth, "Active Sense Queue Management (ASQM)," *IFIP Networking Conference*, Toulouse, FRANCE, May 2015.

88. L. Deek, E. Garcia-Villegas, E. Belding, S.J. Lee, and K. Almeroth, "Joint Rate and Channel Width Adaptation in 802.11 MIMO Wireless Networks," IEEE Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON), New Orleans, LA, USA, June 2013.

87. D. Havey and K. Almeroth, "Fast Wireless Protocol: A Network Stack Design for Wireless Transmission," *IFIP Networking Conference*, Brooklyn, New York, USA, May 2013.

86. M. Tavakolifard, J. Gulla, K. Almeroth, J. Ingvaldsen, G. Nygreen, and E. Berg, "Tailored News in the Palm of Your HAND: A Multi-Perspective Transparent Approach to News Recommendation," *Demo Track at the International World Wide Web Conference (WWW)*, Rio de Janeiro, BRAZIL, May 2013.

85. S. Patterson, M. Wittie, K. Almeroth, and B. Bamieh, "Network Optimization with Dynamic Demands and Link Prices," *Allerton Conference*, Monticello, Illinois, USA, October 2012.

84. D. Havey, R. Chertov, and K. Almeroth, "Receiver Driven Rate Adaptation," *ACM Multimedia Systems Conference (MMSys)*, Chapel Hill, North Carolina, USA, February 2012.

83. M. Tavakolifard and K. Almeroth, "Trust 2.0: Who to Believe in the Flood of Online Data?" *International Conference on Computing, Networking and Communications (ICNC)*, Maui, Hawaii, USA, January 2012.

82. L. Deek, E. Garcia-Villegas, E. Belding, S.J. Lee, and K. Almeroth, "The Impact of Channel Bonding on 802.11n Network Management," *ACM CoNEXT*, Tokyo, JAPAN, December 2011.

81. L. Deek, X. Zhou, K. Almeroth, and H. Zheng, "To Preempt or Not: Tackling Bid and Time-based Cheating in Online Spectrum Auctions," *IEEE Infocom*, Shanghai, CHINA, April 2011.

80. M. Wittie, V. Pejovic, L. Deek, K. Almeroth, and B. Zhao, "Exploiting Locality of Interest in Online Social Networks," *ACM CoNEXT*, Philadelphia, Pennsylvania, USA, November 2010.

79. R. Chertov and K. Almeroth, "Using BGP in a Satellite-Based Challenged Network Environment," *IEEE Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON)*, Boston, Massachusetts, USA, June 2010.

78. R. Chertov, D. Havey and K. Almeroth, "MSET: A Mobility Satellite Emulation Testbed," *IEEE Infocom*, San Diego, California, USA, March 2010.

77. B. Stone-Gross, A. Moser, C. Kruegel, E. Kirda, and K. Almeroth, "FIRE: FInding Rogue nEtworks," *Annual Computer Security Applications Conference (ACSAC)*, Honolulu, Hawaii, USA, December 2009.

76. M. Wittie, K. Almeroth, E. Belding, I. Rimac, and V. Hilt, "Internet Service in Developing Regions Through Network Coding," *IEEE Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON)*, Rome, ITALY, June 2009.

75. R. Chertov and K. Almeroth, "High-Fidelity Link Shaping," *International Conference on Testbeds and Research Infrastructures for the Development of Networks and Communities (TRIDENTCOM)*, Washington DC, USA, April 2009.

74. L. Deek, K. Almeroth, M. Wittie, and K. Harras, "Exploiting Parallel Networks Using Dynamic Channel Scheduling," *International Wireless Internet Conference (WICON)*, Maui, Hawaii, USA, November 2008.

73. D. Havey, E. Barlas, R. Chertov, K. Almeroth, and E. Belding, "A Satellite Mobility Model for QUALNET Network Simulations," *IEEE Military Communications Conference (MILCOM)*, San Diego, California, USA, November 2008.

72. J. Kayfetz and K. Almeroth, "Creating Innovative Writing Instruction for Computer Science Graduate Students," *ASEE/IEEE Frontiers in Education (FIE) Conference*, Saratoga Springs, New York, USA, October 2008.

71. G. Swamynathan, B. Zhao, K. Almeroth, and S. Rao, "Towards Reliable Reputations for Dynamic Networked Systems," *IEEE International Symposium on Reliable Distributed Systems (SRDS)*, Napoli, ITALY, October 2008.

70. B. Stone-Gross, D. Sigal, R. Cohn, J. Morse, K. Almeroth, and C. Krugel, "VeriKey: A Dynamic Certificate Verification System for Public Key Exchanges," *Conference on Detection of Intrusions and Malware & Vulnerability Assessment (DIMVA)*, Paris, FRANCE, July 2008.

69. P. Acharya, A. Sharma, E. Belding, K. Almeroth, K. Papagiannaki, "Congestion-Aware Rate Adaptation in Wireless Networks: A Measurement-Driven Approach," *IEEE Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON)*, San Francisco, California, USA, June 2008.

68. A. Jardosh, P. Suwannatat, T. Hollerer, E. Belding, and K. Almeroth, "SCUBA: Focus and Context for Real-time Mesh Network Health Diagnosis," *Passive and Active Measurement Conference (PAM)*, Cleveland, Ohio, USA, April 2008.

67. B. Stone-Gross, C. Wilson, K. Almeroth, E. Belding, H. Zheng, K. Papagiannaki, "Malware in IEEE 802.11 Wireless Networks," *Passive and Active Measurement Conference (PAM)*, Cleveland, Ohio, USA, April 2008.

66. R. Raghavendra, E. Belding, K. Papagiannaki, and K. Almeroth, "Understanding Handoffs in Large IEEE 802.11 Wireless Networks," *Internet Measurement Conference (IMC)*, San Diego, California, USA, October 2007.

65. M. Wittie, B. Stone-Gross, K. Almeroth and E. Belding, "MIST: Cellular Data Network Measurement for Mobile Applications," *IEEE International Conference on Broadband Communications, Networks, and Systems (BroadNets)*, Raleigh, North Carolina, USA, September 2007.

64. S. Karpinski, E. Belding, K. Almeroth, "Wireless Traffic: The Failure of CBR Modeling," *IEEE International Conference on Broadband Communications, Networks, and Systems (BroadNets)*, Raleigh, North Carolina, USA, September 2007.

63. A. Knight, K. Almeroth, H. Zhang, R. Mayer, and K. DeLeeuw, "Data Cafe: A Dining Car Approach to Educational Research Data Management and Distribution," *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Vancouver, CANADA, June 2007.

62. H. Zhang, K. Almeroth, A. Knight, M. Bulger, and R. Mayer, "Moodog: Tracking Students' Online Learning Activities," *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*,

Vancouver, CANADA, June 2007.

61. M. Bulger, K. Almeroth, R. Mayer, D. Chun, A. Knight, H. Collins, "Effects of Instructor Engagement on Student Use of a Course Management System," Assocation for Psychological Science (APS) Annual Conference, Washington DC, USA, May 2007.

60. R. Mayer, A. Stull, K. Almeroth, B. Bimber, D. Chun, M. Bulger, J. Campbell, Allan Knight, and H. Zhang, "Using Technology-Based Methods to Foster Learning in Large Lecture Classes: Evidence for the Pedagogic Value of Clickers," *American Educational Research Association (AERA) Annual Conference*, Chicago, Illinois, USA, April 2007.

59. K. Ramachandran, I. Sheriff, E. Belding, and K. Almeroth, "Routing Stability in Static Wireless Mesh Networks," *Passive and Active Measurement Conference (PAM)*, Louvain-la-neuve, BELGIUM, April 2007.

58. G. Swamynathan, T. Close, S. Banerjee, R. McGeer, B. Zhao, and K. Almeroth, "Scalable Access Control For Web Services," *International Conference on Creating, Connecting and Collaborating through Computing (C5)*, Kyoto, JAPAN, January 2007.

57. A. Knight, M. Bulger, K. Almeroth, and H. Zhang, "Is Learning Really a Phone Call Away? Knowledge Transfer in Mobile Learning," *World Conference on Mobile Learning (mLearn)*, Banff, Alberta, CANADA, October 2006.

56. J. Kurian, K. Sarac, and K. Almeroth, "Defending Network-Based Services Against Denial of Service Attacks," *International Conference on Computer Communication and Networks (IC3N)*, Arlington, Virginia, USA, October 2006.

55. A. Jardosh, K. Sanzgiri, E. Belding and K. Almeroth, "IQU: Practical Queue-Based User Association Management for WLANs--Case Studies, Architecture, and Implementation," ACM Mobicom, Marina del Rey, California, USA, September 2006.

54. C. Holman, K. Harras, and K. Almeroth, "A Proactive Data Bundling System for Intermittent Mobile Connections," IEEE International Conference on Sensor and Ad Hoc Communications and Networks (SECON), Reston, Virginia, USA, September 2006.

53. G. Banks, M. Cova, V. Felmetsger, K. Almeroth, R. Kemmerer and G. Vigna, "SNOOZE: toward a Stateful NetwOrk prOtocol fuzZEr," *Information Security Conference (ISC)*, Samos Island, GREECE, September 2006.

52. K. Harras and K. Almeroth, "Inter-Regional Messenger Scheduling in Delay Tolerant Mobile Networks," *IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM)*, Niagara Falls, New York, USA, June 2006.

51. M. Bulger, R. Mayer, and K. Almeroth, "Engaged By Design: Using Simulation to Promote Active Learning," **Outstanding Paper** at the *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Orlando, Florida, USA, June 2006.

50. A. Knight, K. Almeroth, R. Mayer, D. Chun, and B. Bimber, "Observations and Recommendations for Using Technology to Extend Interaction," *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Orlando, Florida, USA, June 2006.

49. H. Zhang, and K. Almeroth, "A Simple Classroom Network Access Control System," *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Orlando, Florida, USA, June 2006.

48. K. Harras and K. Almeroth, "Transport Layer Issues in Delay Tolerant Mobile Networks," *IFIP Networking Conference*, Coimbra, PORTUGAL, May 2006.

47. R. Mayer, A. Stull, J. Campbell, K. Almeroth, B. Bimber, D. Chun and A. Knight, "Some Shortcomings of Soliciting Students' Self-Reported SAT Scores," *American Educational Research Association (AERA) Annual*

Conference, San Francisco, California, USA, April 2006.

46. K. Ramachandran, E. Belding, K. Almeroth, and M. Buddhikot, "Interference-Aware Channel Assignment in Multi-Radio Wireless Mesh Networks," *IEEE Infocom*, Barcelona, SPAIN, April 2006.

45. A. Jardosh, K. Ramachandran, K. Almeroth, and E. Belding, "Understanding Congestion in IEEE 802.11b Wireless Networks," *ACM/USENIX Internet Measurement Conference (IMC)*, Berkeley, California, USA, October 2005.

44. H. Zhang, K. Almeroth and M. Bulger, "An Activity Monitoring System to Support Classroom Research," *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Montreal, Quebec, CANADA, pp. 1444-1449, June 2005.

43. Z. Xiang, H. Zhang, J. Huang, S. Song and K. Almeroth, "A Hidden Environment Model for Constructing Indoor Radio Maps," *IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM)*, Taormina, ITALY, June 2005.

42. K. Harras, K. Almeroth and E. Belding, "Delay Tolerant Mobile Networks (DTMNs): Controlled Flooding in Sparse Mobile Networks," *IFIP Networking Conference*, Waterloo, Ontario, CANADA, May 2005.

41. A. Garyfalos and K. Almeroth, "Coupons: Wide Scale Information Distribution for Wireless Ad Hoc Networks," *IEEE Global Telecommunications Conference (Globecom) Global Internet and Next Generation Networks Symposium*, Dallas, Texas, USA, pp. 1655-1659, December 2004.

40. A. Knight and K. Almeroth, "DeCAF: A Digital Classroom Application Framework," *IASTED International Conference on Communications, Internet and Information Technology (CIIT)*, St. Thomas, US Virgin Islands, November 2004.

39. P. Namburi, K. Sarac and K. Almeroth, "SSM-Ping: A Ping Utility for Source Specific Multicast," *IASTED International Conference on Communications, Internet and Information Technology (CIIT)*, St. Thomas, US Virgin Islands, November 2004.

38. K. Ramachandran, E. Belding and K. Almeroth, "DAMON: A Distributed Architecture for Monitoring Multi-hop Mobile Networks," *IEEE International Conference on Sensor and Ad Hoc Communications and Networks (SECON)*, Santa Clara, California, USA, October 2004.

37. A. Garyfalos and K. Almeroth, "Coupon Based Incentive Systems and the Implications of Equilibrium Theory," *IEEE Conference on Electronic Commerce (CEC)*, San Diego, California, USA, pp. 213-220, July 2004.

36. A. Knight, K. Almeroth and B. Bimber, "An Automated System for Plagiarism Detection Using the Internet," *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Lugano, Switzerland, pp. 3619-3625, June 2004.

35. H. Zhang and K. Almeroth, "Supplement to Distance Learning: Design for a Remote TA Support System," *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Lugano, Switzerland, pp. 2821-2830, June 2004.

34. U. Mohan, K. Almeroth and E. Belding, "Scalable Service Discovery in Mobile Ad hoc Networks," *IFIP Networking Conference*, Athens, Greece, pp. 137-149, May 2004.

33. V. Thanedar, K. Almeroth and E. Belding, "A Lightweight Content Replication Scheme for Mobile Ad hoc Environments," *IFIP Networking Conference*, Athens, Greece, pp. 125-136, May 2004.

32. R. Chalmers and K. Almeroth, "A Mobility Gateway for Small-Device Networks," *IEEE International Conference on Pervasive Computing and Communications (PerCom)*, Orlando, Florida, USA, March 2004.

31. A. Jardosh, E. Belding, K. Almeroth and S. Suri, "Towards Realistic Mobility Models For Mobile Ad hoc

Networks," *ACM Mobicom*, San Diego, California, USA, September 2003.

30. K. Sarac, P. Namburi and K. Almeroth, "SSM Extensions: Network Layer Support for Multiple Senders in SSM," *International Conference on Computer Communication and Networks (IC3N)*, Dallas, Texas, USA, October 2003.

29. K. Ramachandran and K. Almeroth, "MAFIA: A Multicast Management Solution for Access Control and Traffic Filtering," *IEEE/IFIP Conference on Management of Multimedia Networks and Services (MMNS)*, Belfast, Northern Ireland, September 2003.

28. J. Humfrey, S. Rollins, K. Almeroth, and B. Bimber, "Managing Complexity in a Networked Learning Environment," *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Honolulu, Hawaii, USA, pp. 60-63, June 2003.

27. K. Almeroth, S. Rollins, Z. Shen, and B. Bimber, "Creating a Demarcation Point Between Content Production and Encoding in a Digital Classroom," *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Honolulu, Hawaii, USA, pp. 2-5, June 2003.

26. M. Kolsch, K. Kvilekval, and K. Almeroth, "Improving Speaker Training with Interactive Lectures," *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Honolulu, Hawaii, USA, June 2003.

25. P. Rajvaidya and K. Almeroth, "Analysis of Routing Characteristics in the Multicast Infrastructure," *IEEE Infocom*, San Francisco, California, USA, April 2003.

24. S. Rollins and K. Almeroth, "Pixie: A Jukebox Architecture to Support Efficient Peer Content Exchange," *ACM Multimedia*, Juan Les Pins, FRANCE, December 2002.

23. S. Rollins, R. Chalmers, J. Blanquer, and K. Almeroth, "The Active Information System(AIS): A Model for Developing Scalable Web Services," *IASTED International Conference on Internet and Multimedia Systems and Applications (IMSA)*, Kauai, Hawaii, USA, August 2002.

22. S. Rollins and K. Almeroth, "Seminal: Additive Semantic Content for Multimedia Streams," *IASTED International Conference on Internet and Multimedia Systems and Applications (IMSA)*, Kauai, Hawaii, USA, August 2002.

21. B. Stiller, K. Almeroth, J. Altmann, L. McKnight, and M. Ott, "Content Pricing in the Internet," *SPIE ITCom Conference on Internet Performance and Control of Network Systems (IPCNS)*, Boston, Massachusetts, USA, July 2002.

20. S. Jagannathan, J. Nayek, K. Almeroth and M. Hofmann, "A Model for Discovering Customer Value for E-Content," *ACM International Conference on Knowledge Discovery and Data Mining (SIGKDD)*, Edmonton, Alberta, CANADA, July 2002.

19. S. Rollins and K. Almeroth, "Deploying and Infrastructure for Technologically Enhanced Learning," **Outstanding Paper** at the *World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA)*, Denver, Colorado, USA, pp. 1651-1656, June 2002.

18. P. Rajvaidya and K. Almeroth, "Building the Case for Distributed Global Multicast Monitoring," *Multimedia Computing and Networking (MMCN)*, San Jose, California, USA, January 2002.

17. S. Jagannathan and K. Almeroth, "An Adaptive Pricing Scheme for Content Delivery Systems," *IEEE Global Internet*, San Antonio, Texas, USA, November 2001.

16. K. Sarac and K. Almeroth, "Providing Scalable Many-to-One Feedback in Multicast Reachability Monitoring Systems," *IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS)*, Chicago, Illinois, USA, October 2001.

15. S. Jagannathan and K. Almeroth, "The Dynamics of Price, Revenue and System Utilization," *IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS)*, Chicago, Illinois, USA, October 2001.

14. A. Kanwar, K. Almeroth, S. Bhattacharyya, and M. Davy, "Enabling End-User Network Monitoring via the Multicast Consolidated Proxy Monitor," *SPIE ITCom Conference on Scalability and Traffic Control in IP Networks (STCIPN)*, Denver, Colorado, USA, August 2001.

13. S. Jagannathan and K. Almeroth, "Using Tree Topology for Multicast Congestion Control," *International Conference on Parallel Processing (ICPP)*, Valencia, SPAIN, September 2001.

12. P. Rajvaidya and K. Almeroth, "A Router-Based Technique for Monitoring the Next-Generation of Internet Multicast Protocols," *International Conference on Parallel Processing (ICPP)*, Valencia, SPAIN, September 2001.

11. R. Chalmers and K. Almeroth, "Modeling the Branching Characteristics and Efficiency Gains of Global Multicast Trees," *IEEE Infocom*, Anchorage, Alaska, USA, April 2001.

10. R. Chalmers and K. Almeroth, "Developing a Multicast Metric," *Global Internet*, San Francisco, California, USA, December 2000.

9. K. Sarac and K. Almeroth, "Monitoring Reachability in the Global Multicast Infrastructure," *IEEE International Conference on Network Protocols (ICNP)*, Osaka, JAPAN, November 2000.

8. K. Almeroth, "A Long-Term Analysis of Growth and Usage Patterns in the Multicast Backbone (MBone)," *IEEE INFOCOM*, Tel Aviv, ISRAEL, March 2000.

7. K. Almeroth, K. Obraczka and D. De Lucia, "A Lightweight Protocol for Interconnecting Heterogeneous Devices in Dynamic Environments," *IEEE International Conference on Multimedia Computing and Systems (ICMCS)*, Florence, ITALY, June 1999.

6. K. Almeroth and M. Ammar, "The Interactive Multimedia Jukebox (IMJ): A New Paradigm for the On-Demand Delivery of Audio/Video," **Best Paper** at *the Seventh International World Wide Web Conference (WWW)*, Brisbane, AUSTRALIA, April 1998.

5. K. Almeroth, M. Ammar and Z. Fei, "Scalable Delivery of Web Pages Using Cyclic Best-Effort (UDP) Multicast," *IEEE INFOCOM*, San Francisco, California, USA, June 1998.

4. K. Almeroth and M. Ammar, "Delivering Popular Web Pages Using Cyclic Unreliable Multicast (Extended Abstract)," *SPIE Conference on Voice, Video and Data Communications*, Dallas, Texas, USA, November 1997.

3. K. Almeroth, A. Dan, D. Sitaram and W. Tetzlaff, "Long Term Resource Allocation in Video Delivery Systems," *IEEE INFOCOM*, Kobe, JAPAN, April 1997.

2. K. Almeroth and M. Ammar, "On the Performance of a Multicast Delivery Video-On-Demand Service with Discontinuous VCR Actions," *International Conference on Communications (ICC)*, Seattle, Washington, USA, June 1995.

1. K. Almeroth and M. Ammar, "A Scalable, Interactive Video-On-Demand Service Using Multicast Communication," *International Conference on Computer Communication and Networks (IC3N)*, San Francisco, California, USA, September 1994.

C. Workshop Papers (refereed)

34. M. Tavakolifard, J. Gulla, K. Almeroth, F. Hopfgartner, B. Kille, T. Plumbaum, A. Lommatzsch, T. Brodt, A.

Bucko, and T. Heintz, "Workshop and Challenge on News Recommender Systems," *ACM RecSys News Recommender Systems (NRS) Workshop and Challange*, Hong Kong, CHINA, October 2013.

33. M. Tavakolifard, K. Almeroth, and J. Gulla, "Does Social Contact Matter? Modelling the Hidden Web of Trust Underlying Twitter," *ACM International Workshop on Social Recommender Systems (SRS)*, Rio de Janeiro, BRAZIL, May 2013.

32. D. Johnson, E. Belding, K. Almeroth and G. van Stam, "Internet Usage and Performance Analysis of a Rural Wireless Network in Macha, Zambia," *ACM Networked Systems for Developing Regions (NSDR) Workshop*, San Francisco, California, USA, June 2010.

31. D. Havey, R. Chertov, and K. Almeroth, "Wired Wireless Broadcast Emulation," *International Workshop on Wireless Network Measurement (WiNMee)*, Seoul, Korea, June 2009.

30. R. Raghavendra, P. Acharya, E. Belding, and K. Almeroth, "MeshMon: A Multi-Tiered Framework for Wireless Mesh Network Monitoring," *ACM Mobihoc Wireless of the Students, by the Students, for the Students Workshop (S3)*, New Orleans, Louisiana, USA, May 2009.

29. G. Swamynathan, C. Wilson, B. Boe, B. Zhao, and K. Almeroth, "Do Social Networks Improve e-Commerce: A Study on Social Marketplaces," *ACM Sigcomm Workshop on Online Social Networks (WOSN)*, Seattle, Washington, USA, August 2008.

28. R. Raghavendra, E. Belding, and K. Almeroth, "Antler: A Multi-Tiered Approach to Automated Wireless Network Management," *IEEE Workshop on Automated Network Management (ANM)*, Phoenix, Arizona, USA, April 2008.

27. S. Karpinski, E. Belding, and K. Almeroth, "Towards Realistic Models of Wireless Workload," *International Workshop on Wireless Network Measurement (WiNMee)*, Limassol, CYPRUS, April 2007.

26. K. Harras, M. Wittie, K. Almeroth, and E. Belding, "ParaNets: A Parallel Network Architecture for Challenged Networks," *IEEE Workshop on Mobile Computing Systems and Applications (HotMobile)*, Tucson, Arizona, USA, February 2007.

25. H. Caituiro-Monge, K. Almeroth, M. del Mar Alvarez-Rohena, "Friend Relay: A Resource Sharing Framework for Mobile Wireless Devices," *ACM International Workshop on Wireless Mobile Applications and Services on WLAN Hotspots (WMASH)*, Los Angeles, California, September 2006.

24. G. Swamynathan, Ben Y. Zhao and K. Almeroth, "Exploring the Feasibility of Proactive Reputations," *International Workshop on Peer-to-Peer Systems (IPTPS)*, Santa Barbara, California, USA, February 2006.

23. G. Swamynathan, Ben Y. Zhao and K. Almeroth, "Decoupling Service and Feedback Trust in a Peer-to-Peer Reputation System," *International Workshop on Applications and Economics of Peer-to-Peer Systems (AEPP)*, Nanjing, CHINA, November 2005.

22. K. Ramachandran, M. Buddhikot, G. Chandranmenon, S. Miller, E. Belding, and K. Almeroth, "On the Design and Implementation of Infrastructure Mesh Networks," *IEEE Workshop on Wireless Mesh Networks (WiMesh)*, Santa Clara, California, USA, September 2005.

21. A. Jardosh, K. Ramachandran, K. Almeroth and E. Belding, "Understanding Link-Layer Behavior in Highly Congested IEEE 802.11b Wireless Networks," *Sigcomm Workshop on Experimental Approaches to Wireless Network Design and Analysis (EWIND), Philadelphia, Pennsylvania, USA, August 2005.

20. A. Sen Mazumder, K. Almeroth and K. Sarac, "Facilitating Robust Multicast Group Management," *Network and Operating System Support for Digital Audio and Video (NOSSDAV)* , Skamania, Washington, USA, June 2005.

19. Y. Sun, I. Sheriff, E. Belding and K. Almeroth, "An Experimental Study of Multimedia Traffic Performance in Mesh Networks," *MobiSys International Workshop on Wireless Traffic Measurements and Modeling (WitMeMo),

Seattle, Washington, USA, June 2005.

18. K. Ramachandran, K. Almeroth and E. Belding, "A Framework for the Management of Large-Scale Wireless Network Testbeds," *International Workshop on Wireless Network Measurement (WiNMee)*, Trentino, ITALY, April 2005.

17. A. Garyfalos, K. Almeroth and K. Sanzgiri, "Deployment Complexity Versus Performance Efficiency in Mobile Multicast," *International Workshop on Broadband Wireless Multimedia: Algorithms, Architectures and Applications (BroadWiM)*, San Jose, California, USA, October 2004.

16. C. Ho, K. Ramachandran, K. Almeroth and E. Belding, "A Scalable Framework for Wireless Network Monitoring," *ACM International Workshop on Wireless Mobile Applications and Services on WLAN Hotspots (WMASH)*, Philadelphia, Pennsylvania, USA, October 2004.

15. A. Garyfalos, K. Almeroth and J. Finney, "A Hybrid of Network and Application Layer Multicast for Mobile IPv6 Networks," *International Workshop on Large-Scale Group Communication (LSGC)*, Florence, ITALY, October 2003.

14. A. Garyfalos, K. Almeroth and J. Finney, "A Comparison of Network and Application Layer Multicast for Mobile IPv6 Networks," *ACM Workshop on Modeling, Analysis and Simulation of Wireless and Mobile Systems (MSWiM)*, San Diego, California, USA, September 2003.

13. S. Jagannathan, and K. Almeroth, "Pricing and Resource Provisioning for Delivering E-Content On-Demand with Multiple Levels-of-Service," *International Workshop on Internet Charging and QoS Technologies (ICQT)*, Zurich, SWITZERLAND, October 2002.

12. S. Rollins, K. Almeroth, D. Milojicic, and K. Nagaraja, "Power-Aware Data Management for Small Devices," *Workshop on Wireless Mobile Multimedia (WoWMoM)*, Atlanta, GA, USA, September 2002.

11. K. Almeroth, S. Bhattacharyya, and C. Diot, "Challenges of Integrating ASM and SSM IP Multicast Protocol Architectures," *International Workshop on Digital Communications: Evolutionary Trends of the Internet (IWDC)*, Taormina, ITALY, September 2001.

10. K. Sarac and K. Almeroth, "Scalable Techniques for Discovering Multicast Tree Topology," *Network and Operating System Support for Digital Audio and Video (NOSSDAV)* , Port Jefferson, New York, USA, June 2001.

9. P. Rajvaidya, K. Almeroth and K. Claffy, "A Scalable Architecture for Monitoring and Visualizing Multicast Statistics," *IFIP/IEEE International Workshop on Distributed Systems: Operations & Management (DSOM)*, Austin, Texas, USA, December 2000.

8. S. Jagannathan, K. Almeroth and A. Acharya, "Topology Sensitive Congestion Control for Real-Time Multicast," *Network and Operating System Support for Digital Audio and Video (NOSSDAV)* , Chapel Hill, North Carolina, USA, June 2000.

7. K. Sarac and K. Almeroth, "Supporting the Need for Inter-Domain Multicast Reachability," *Network and Operating System Support for Digital Audio and Video (NOSSDAV)* , Chapel Hill , North Carolina, USA, June 2000.

6. D. Makofske and K. Almeroth, "MHealth: A Real-Time Multicast Tree Visualization and Monitoring Tool," *Network and Operating System Support for Digital Audio and Video (NOSSDAV)* , Basking Ridge New Jersey, USA, June 1999.

5. K. Almeroth and Y. Zhang, "Using Satellite Links as Delivery Paths in the Multicast Backbone (MBone)," *ACM/IEEE International Workshop on Satellite-Based Information Services (WOSBIS)*, Dallas, Texas, USA, October 1998.

4. M. Ammar, K. Almeroth, R. Clark and Z. Fei, "Multicast Delivery of Web Pages OR How to Make Web Servers

Pushy," *Workshop on Internet Server Performance (WISP)*, Madison, Wisconsin, USA, June 1998.

3. K. Almeroth and M. Ammar, "Prototyping the Interactive Multimedia Jukebox," *Mini-conference on Multimedia Appliances, Interfaces, and Trials--International Conference on Communications (ICC)*, Montreal, Quebec, CANADA, June 1997.

2. K. Almeroth and M. Ammar, "Collection and Modeling of the Join/Leave Behavior of Multicast Group Members in the MBone," *High Performance Distributed Computing Focus Workshop (HPDC)*, Syracuse, New York, USA, August 1996.

1. K. Almeroth and M. Ammar, "The Role of Multicast Communication in the Provision of Scalable and Interactive Video-On-Demand Service," *Network and Operating System Support for Digital Audio and Video (NOSSDAV)* , Durham, New Hampshire, USA, April 1995.

D. Non-Refereed Publications

8. K. Almeroth, E. Belding, M. Buddhikot, G. Chandranmenon, S. Miller, and K. Ramachandran, "Infrastructure Mesh Networks," *U.S. Patent Application US20070070959 A1*, September 2005.

7. K. Almeroth, R. Caceres, A. Clark, R. Cole, N. Duffield, T. Friedman, K. Hedayat, K. Sarac, M. Westerlund, "RTP Control Protocol Extended Reports (RTCP XR)," *Internet Engineering Task Force (IETF) Request for Comments (RFC) 3611*, November 2003.

6. Z. Albanna, K. Almeroth, D. Meyer, and M. Schipper, "IANA Guidelines for IPv4 Multicast Address Allocation," *Internet Engineering Task Force (IETF) Request for Comments (RFC) 3171*, August 2001.

5. B. Quinn and K. Almeroth, "IP Multicast Applications: Challenges and Solutions," *Internet Engineering Task Force (IETF), Request for Comments (RFC) 3170*, September 2001.

4. K. Almeroth, L. Wei and D. Farinacci, "Multicast Reachability Monitor (MRM) Protocol," *Internet Engineering Task Force Internet Draft*, July 2000.

3. K. Almeroth and L. Wei, "Justification for and use of the Multicast Reachability Monitor (MRM) Protocol," *Internet Engineering Task Force Internet Draft*, March 1999.

2. K. Almeroth, "Managing IP Multicast Traffic: A First Look at the Issues, Tools, and Challenges," IP Multicast Initiative White Paper, San Jose, California, USA, February 1999.

1. K. Almeroth, K. Obraczka and D. De Lucia, "Pseudo-IP: Providing a Thin Network Protocol for Semi-Intelligent Wireless Devices," *DARPA/NIST Smart Spaces Workshop*, Gaithersburg, Maryland, USA, July 1998.

E. Released Software Systems

19. *A Multi-radio Wireless Mesh Network Architecture -- http://moment.cs.ucsb.edu/tic/.* Released December 1, 2006 (with K. Ramachandran, I. Sheriff, and E. Belding). The software as part of a multi-radio wireless mesh network that includes a Split Wireless Router that alleviates the interference that can occur between commodity radios within a single piece of hardware. The second is server software to perform channel assignment and communicate the assignments throughout the mesh network.

18. *AODV-Spanning Tree (AODV-ST) -- http://www.cs.ucsb.edu/~krishna/aodv-st/.* Released September 1, 2006 (with K. Ramachandran and E. Belding). AODV-ST is an extension of the well-known AODV protocol specifically

designed for wireless mesh networks. The advantages of AODV-ST over AODV include support for high throughput routing metrics, automatic route maintenance for common-case traffic, and low route discovery latency.

17. *The Multicast Detective -- http://www.nmsl.cs.ucsb.edu/mcast_detective/.* Released September 1, 2005 (with A. Sen Mazumder). The multicast detective is a robust solution to determine the existence and nature of multicast service for a particular user. By performing a series of tests, a user can determine whether there is network support for multicast, and consequently, whether a multicast group join is likely to succeed.

16. *AutoCap: Automatic and Accurate Captioning -- http://www.nmsl.cs.ucsb.edu/autocap/.* Released August 1, 2005 (with A. Knight). AutoCap is a software system that takes as input an audio/video file and a text transcript. AutoCap creates captions by aligning the utterances in the audio/video file to the transcript. For those words that are not recognized, AutoCap estimates when the words were spoken along with an error bound that gives the content creator an idea of caption accuracy. The result is a collection of accurately time-stamped captions that can be displayed with the video.

15. *PAIRwise Plagiarism Detection System -- http://cits.ucsb.edu/pair/.* Released July 1, 2005 (with A. Knight). PAIRwise is a plagiarism detection system with: (1) an easy-to-use interface for submitting papers, (2) a flexible comparison engine that allows intra-class, inter-class, and Internet-based comparisons, and (3) an intuitive graphical presentation of results.

14. *DAMON Multi-Hop Wireless Network Monitoring -- http://moment.cs.ucsb.edu/damon/.* Released October 1, 2004 (with K. Ramachandran and E. Belding). DAMON is a distributed system for monitoring multi-hop mobile networks. DAMON uses agents within the network to monitor network behavior and send collected measurements to data repositories. DAMON's generic architecture supports the monitoring of a wide range of protocol, device, or network parameters.

13. *Multicast Firewall -- http://www.nmsl.cs.ucsb.edu/mafia/.* Released June 1, 2004 (with K. Ramachandran). MAFIA, a multicast firewall and traffic management solution, has the specific aim of strengthening multicast security through multicast access control, multicast traffic filtering, and DoS attack prevention.

12. *AODV@IETF Peer Routing Software-- http://moment.cs.ucsb.edu/aodv-ietf/.* Released November 1, 2003 (with K. Ramachandran and E. Belding). One of the first large-scale efforts to run the Ad hoc On demand Distance Vector (AODV) routing protocol in a public space (at the Internet Engineering Task Force (IETF)). The implementation includes a daemon that runs on both the Linux and Windows operating systems.

11. *Mobility Obstacles -- http://moment.cs.ucsb.edu/mobility/.* Released September 1, 2003 (with A. Jardosh, E. Belding, and S. Suri). The topology and movement of nodes in ad hoc protocol simulation are key factors in protocol performance. In this project, we have developed ns-2 simulation plug-ins that create more realistic movement models through the incorporation of obstacles. These obstacles are utilized to restrict both node movement and wireless transmissions.

10. *mwalk -- http://www.nmsl.cs.ucsb.edu/mwalk/.* Released December 1, 2000 (with R. Chalmers). Mwalk is a collection of Java applications and Perl scripts which re-create a global view of a multicast session from mtrace and RTCP logs. Users to the site can download mwalk, examine the results of our analysis, or download data sets for use in simulations dependent on multicast tree characteristics.

9. *MANTRA2 -- http://www.nmsl.cs.ucsb.edu/mantra/.* Released December 1, 1999 (with P. Rajvaidya). This new version of MANTRA focuses on the visualization of inter-domain routing statistics. Working in conjunction with the Cooperative Association for Internet Data Analysis (CAIDA) we have developed advanced collection and visualization techniques.

8. *MRM -- http://www.nmsl.cs.ucsb.edu/mrm/.* Released October 1, 1999 (with K. Sarac). MRM is the Multicast Reachability Protocol. We have implemented an end-host agent that responds to MRM Manager commands. Our end-host agent works in conjunction with Cisco routers to detect and isolate multicast faults.

7. *MANTRA -- http://www.nmsl.cs.ucsb.edu/mantra/.* Released January 1, 1999 (with P. Rajvaidya). MANTRA is the Monitoring and Analysis of Traffic in Multicast Routers. It uses scripts to collect and display data from backbone multicast routers.

6. *SDR Monitor -- http://www.nmsl.cs.ucsb.edu/sdr-monitor/.* Released January 1, 1999 (with K. Sarac). The SDR Monitor receives e-mail updates from participants containing information about observed sessions in the MBone. A global view of multicast reachability is then constructed.

5. *The MHealth tool -- http://www.nmsl.cs.ucsb.edu/mhealth/.* Released September 1, 1998 (with D. Makofske). The mhealth tool graphically visualizes MBone multicast group trees and provides `health' information including end-to-end losses per receiver and losses on a per hop basis. The implementation required expertise in Java, the MBone tools, and Unix.

4. *The MControl tool -- http://www.nmsl.cs.ucsb.edu/mcontrol/.* Released August 1, 1998 (with D. Makofske). Mcontrol is a tool to provide VCR-based interactivity for live MBone sessions. The implementation required expertise in Java, the MBone tools, and Unix.

3. *Interactive Multimedia Jukebox (IMJ) -- http://imj.ucsb.edu/.* Released October 1, 1996. The IMJ combines the WWW and the MBone conferencing tools to provide a multi-channel video jukebox offering both instructional and entertainment programming on a wide scale. The implementation required expertise in HTML, Perl, C, the MBone tools, and Unix.

2. *Mlisten -- http://www.cc.gatech.edu/computing/Telecomm/mbone/.* Released September 1, 1995. A tool to continuously collect MBone multicast group membership information including number and location of members, membership duration, and inter-arrival time for all audio and video sessions. The implementation required expertise in C, Tcl/Tk, the MBone tools, and UNIX socket programming.

1. *Audio-on-Demand (AoD)*. March 1, 1995. A server/client prototype to demonstrate interactivity in near VoD systems. The AoD server provides songs-on-demand and VCR-like functions via multicast IP over Ethernet. The implementation required expertise in C, OpenWindows programming, UNIX socket programming, and network programming.

F. Tutorials, Panels and Invited Talks

- "25th Anniversary Panel," Network and Operating System Support for Digital Audio and Video (NOSSDAV), Portland, Oregon, USA, March 2015.

- "Sensing and Opportunistic Delivery of Ubiquitous Video in Health Monitoring, On-Campus and Social Network Applications," Workshop on Mobile Video Delivery (MoViD), Chapel Hill North Carolina, USA, February 2012.

- "Medium Access in New Contexts: Reinventing the Wheel?," USC Invited Workshop on Theory and Practice in Wireless Networks, Los Angeles, California, USA, May 2008.

- "The Wild, Wild West: Wireless Networks Need a New Sheriff," University of Florida CISE Department Lecture Series, Gainesville, Florida, USA, February 2008.

- "Distinguishing Between Connectivity, Intermittent Connectivity, and Intermittent Disconnectivity," Keynote at the ACM MobiCom Workshop on Challenged Networks (CHANTS), Montreal, CANADA, September 2007.

- "The Three Ghosts of Multicast: Past, Present, and Future," Keynote at the Trans-European Research and Education Networking Association (TERENA) Networking Conference, Lynby, DENMARK, May 2007.

- "Multicast Help Wanted: From Where and How Much?," Keynote at the Workshop on Peer-to-Peer Multicasting

(P2PM), Las Vegas, Nevada, USA, January 2007.

- "The Confluence of Wi-Fi and Apps: What to Expect Next," Engineering Insights, UC-Santa Barbara, Santa Barbara, California, USA, October 2006.

- "Challenges, Opportunities, and Implications for the Future Internet," University of Minnesota Digital Technology Center, Minneapolis, Minnesota, USA, September 2006.

- "Wireless Technology as a Catalyst: Possibilities for Next-Generation Interaction," Santa Barbara Forum on Digital Transitions, Santa Barbara, California, USA, April 2006.

- "Challenges and Opportunities in an Internet with Pervasive Wireless Access," University of Texas--Dallas Computer Science Colloquium, Dallas, Texas, USA, March 2006.

- "Challenges and Opportunities with Pervasive Wireless in the Internet," Duke University Computer Science Colloquium, Durham, North Carolina, USA, February 2006.

- "The Span From Wireless Protocols to Social Applications," Intel Research Labs, Cambridge, United Kingdom, December 2005.

- "The Internet Dot.Com Bomb and Beyond the Dot.Com Calm," CSE IGERT and Cal Poly Lecture Series, San Luis Obispo, California, USA, October 2005.

- "Panel: Directions in Networking Research," IEEE Computer Communications Workshop (CCW), Irvine, California, USA, October 2005.

- "Economic Incentives for Ad Hoc Networks," KAIST New Applications Seminar, Seoul, South Korea, March 2004.

- "New Applications for the Next Generation Internet," Citrix Systems, Santa Barbara, California, USA, March 2004.

- "PI: The Imperfect Pursuit of Pure Pattern," CITS Visions in Technology Series, Santa Barbara, California, USA, January 2004.

- "Panel: Core Networking Issues and Protocols for the Internet," National Science Foundation (NSF) Division of Advanced Networking Infrastructure and Research (ANIR) Principal Investigators Workshop, Washington DC, USA, March 2003.

- "Panel: Pricing for Content in the Internet," SPIE ITCom Internet Performance and Control of Network Systems, Boston, Massachusetts, USA, July 2002.

- "The Technology Behind Wireless LANs," Central Coast MIT Enterprise Forum, Santa Barbara, California, USA, March 2002.

- "Lessons Learned in the Digital Classroom," Center for Information and Technology Brown Bag Symposium, Santa Barbara, California, USA, March 2002.

- "The Evolution of Advanced Networking Services: From the ARPAnet to Internet2," California State University--San Luis Obispo CS Centennial Colloquium Series, San Luis Obispo, California, USA, February 2002.

- "Deployment of IP Multicast in Campus Infrastructures," Internet2 Campus Deployment Workshop, Atlanta, Georgia, USA, May 2001.

- "Multicast: Is There Anything Else to Do?," Sprint Research Retreat, Miami, Florida, USA, May 2001.

- "The Evolution of Next-Generation Internet Services and Applications," Government Technology Conference 2001 (GTC) for the Western Region, Sacramento, California, USA, May 2001.

- "I2 Multicast: Not WIDE-scale Deployment, FULL-scale Deployment," Closing Plenary, Internet2 Member Meetings, Washington, D.C., USA, March 2001.

- "Panel: Beyond IP Multicast," Content Delivery Networks (CDN), New York, New York, USA, February 2001.

- "Viable Multicast Pricing & Business Models for Wider-Scale Deployment," Content Delivery Networks (CDN), New York, New York, USA, February 2001.

- "IP Multicast: Modern Protocols, Deployment, and Management," Content Delivery Networks (CDN), New York, New York, USA, February 2001 & San Jose, California, USA, December 2001.

- "Under the Hood of the Internet," Technology 101: Technology for Investors, Center for Entrepreneurship & Engineering Management, November 2000.

- "Understanding Multicast Traffic in the Internet," (1) University of Virginia, (2) University of Maryland, and (3) Columbia University, September 2000.

- "The Bad, The Ugly, and The Good: The Past, Present, and Future of Multicast," Digital Fountain, San Francisco, California, USA, August 2000.

- "Implications of Source-Specific Multicast (SSM) on the Future of Internet Content Delivery," Occam Networks, Santa Barbara, California, USA, August 2000.

- "Introduction to Multicast Routing Protocols," UC-Berkeley Open Mash Multicast Workshop, Berkeley, California, USA, July 2000.

- "Efforts to Understand Traffic and Tree Characteristics," University of Massachusetts--Amherst Colloquia, Amherst, Massachusetts, USA, May 2000.

- "Monitoring Multicast Traffic," Sprint Research Retreat, Half Moon Bay, California, USA, April 2000.

- "What is the Next Generation of Multicast in the Internet?," HRL Laboratories, Malibu, California, USA, January 2000.

- "Mission and Status of the Center for Information Technology and Society (CITS)," Intel Research Council, Portland, Oregon, USA, September 1999.

- "Multicast at a Crossroads," IP Multicast Initiative Summits and Bandwidth Management Workshops, San Francisco, CA, USA, (1) October 1999; (2) February 2000; and (3) June 2000.

- "IP Multicast: Modern Protocols, Deployment, and Management," Networld+Interop: (1) Las Vegas, Nevada, USA--May 2000; (2) Tokyo, JAPAN--June 2000; (3) Atlanta, Georgia, USA--September 2000; (4) Las Vegas, Nevada, USA--May 2001; (5) Las Vegas, Nevada, USA--May 2002.

- "IP Multicast: Practice and Theory" (w/ Steve Deering), Networld+Interop: (1) Las Vegas, Nevada, USA--May 1999; (2) Tokyo, JAPAN--June 1999; and (3) Atlanta, Georgia, USA--September 1999.

- "Internet2 Multicast Testbeds and Applications," Workshop on Protocols for High Speed Networks (PfHSN), Salem, Massachusetts, USA, August 1999.

- "IP Multicast: Protocols for the Intra- and Inter-Domain," Lucent Technologies, Westford, Massachusetts, USA, August 1999.

- "Internet2 Multicast Testbeds and Applications," NASA Workshop: Bridging the Gap, Moffett Field, California, USA, August 1999.

- "The Evolution of Next-Generation Services and Applications in the Internet," Tektronix Distinguished Lecture

Series, Portland, Oregon, USA, May 1999.

- "Multicast Applications and Infrastructure in the Next Generation Internet," CENIC 99 Workshop on Achieving Critical Mass for Advanced Applications, Monterey, California, USA, May 1999.

- "Multicast Traffic Monitoring and Analysis Work at UCSB" (w/ P. Rajvaidya), Workshop on Internet Statistics and Metrics Analysis (ISMA), San Diego, California, USA, April 1999.

- "How the Internet Works: Following Bits Around the World," Science Lite, Santa Barbara General Affiliates and Office of Community Relations, California, USA, February 1999.

- "Managing Multicast: Challenges, Tools, and the Future," IP Multicast Initiative Summit, San Jose, California, USA, February 1999.

- "The Future of Multicast Communication and Protocols," Internet Bandwidth Management Summit (iBAND), San Jose, California, USA, November 1998.

- "An Overview of IP Multicast: Applications and Deployment," (1) Workshop on Evaluating IP Multicast as the Solution for Webcasting Real-Time Networked Multimedia Applications, New York, New York, USA, July 1998; and (2) Satellites and the Internet Conference, Washington, D.C., USA, July 1998.

- "IETF Developments in IP Multicast," IP Multicast Initiative Summit, San Jose, California, USA, February 1998.

- "An Introduction to IP Multicast and the Multicast Backbone (MBone)" vBNS Technical Meeting sponsored by the National Center for Network Engineering (NLANR), San Diego, California, USA, February 1998.

- "Using Multicast Communication to Deliver WWW Pages" Computer Communications Workshop (CCW '97), Phoenix, Arizona, USA, September 1997.

G. Research Funding

- K. Almeroth, "Packet Scheduling Using IP Embedded Transport Instrumentation," Cisco Systems Inc., $100,000, 3/1/13-8/31/14.

- K. Almeroth, E. Belding and S.J. Lee, "GOALI: Maximizing Available Bandwidth in Next Generation WLANs", National Science Foundation (NSF), $101,088, 10/1/13-9/30/14.

- K. Almeroth and E. Belding, "GOALI: Intelligent Channel Management in 802.11n Networks," National Science Foundation (NSF), $51,000, 10/1/10-9/30/11.

- B. Zhao, K. Almeroth, H. Zheng, and E. Belding, "NeTS: Medium: Airlab: Distributed Infrastructure for Wireless Measurements," National Science Foundation (NSF), $700,000, 9/1/09-8/13/13.

- K. Almeroth, E. Belding and T. Hollerer, "NeTS-WN: Wireless Network Health: Real-Time Diagnosis, Adaptation, and Management," National Science Foundation (NSF), $600,000, 10/1/07-9/30/10.

- K. Almeroth, "Next-Generation Service Engineering in Internet2," University Consortium for Advanced Internet Development (UCAID), $1,254,000, 7/1/04-6/30/09 (reviewed and renewed each year).

- B. Manjunath, K. Almeroth, F. Bullo, J. Hespanha, T. Hollerer, C. Krintz, U. Madhow, K. Rose, A. Singh, and M. Turk, "Large-Scale Multimodal Wireless Sensor Network," Office of Naval Research Defense University Research Instrumentation Program (DURIP), $655,174, 4/14/08-4/14/09.

- K. Almeroth and E. Belding, "Improving Robustness in Evolving Wireless Infrastructures," Intel Corporation,

$135,000, 7/1/06-6/30/09 (reviewed and renewed for second and third year).

- K. Almeroth and K. Sarac, "Bridging Support in Mixed Deployment Multicast Environments," Cisco Systems Inc., $100,000, 9/1/07-8/31/08.

- K. Sarac and K. Almeroth, "Building the Final Piece in One-to-Many Content Distribution," Cisco Systems Inc., $95,000, 9/1/06-8/31/07.

- E. Belding, K. Almeroth and J. Gibson, "Real-Time Communication Support in a Ubiquitous Next-Generation Internet," National Science Foundation (NSF), $900,000, 10/1/04-9/30/07.

- K. Almeroth and K. Sarac, "Improving the Robustness of Multicast in the Internet," Cisco Systems Inc., $80,000, 9/1/04-8/31/05.

- R. Mayer, B. Bimber, K. Almeroth and D. Chun, "Assessing the Pedagogical Implications of Technology in College Courses," Mellon Foundation, $350,000, 7/1/04-6/30/07.

- B. Bimber, A. Flanagin and C. Stol, "Technological Change and Collective Association: Changing Relationships Among Technology, Organizations, Society and the Citizenry," National Science Foundation (NSF), $329,175, 7/1/04-6/30/07.

- K. Almeroth and B. Bimber, "Plagiarism Detection Techniques and Software," UCSB Instructional Development, $22,000, 7/1/04-6/30/05.

- K. Almeroth, "Student Travel Support for the 14th International Workshop on Network and Operating Systems Support for Digital Audio and Video (NOSSDAV)," National Science Foundation (NSF), $10,000, 5/1/04-8/31/04.

- K. Almeroth, "An Automated Indexing System for Remote, Archived Presentations," QAD Inc., $25,000, 5/1/04-6/30/05.

- K. Almeroth and M. Turk, "A Remote Teaching Assistant Support System," Microsoft, $40,000, 1/1/04-6/30/05.

- K. Almeroth, "Supporting Multicast Service Functionality in Helix," Real Networks, $30,000, 9/1/03-6/30/04.

- K. Almeroth and E. Belding, "Service Discovery in Mobile Networks," Nokia Summer Research Grant (U. Mohan), $10,240, 7/1/03-9/30/03.

- K. Almeroth, D. Zappala, "Building a Global Multicast Service," Cisco Systems Inc., $100,000, 1/1/03-indefinite.

- K. Almeroth, "Developing A Dynamic Protocol for Candidate Access Router Discovery," Nokia Graduate Student Fellowship (R. Chalmers), $26,110, 9/01/02-6/30/03.

- B. Bimber and K. Almeroth, "The Role of Collaborative Groupware in Organizations," Toole Family Foundation, $182,500 ($20,000 cash plus $162,500 in software), 9/1/02-indefinite.

- B. Manjunath, et al., "Digital Multimedia: Graduate Training Program in Interactive Digital Multimedia," National Science Foundation (NSF), $2,629,373, 4/1/02-3/31/07.

- J. Green, K. Almeroth, et al., "Inquiry in the Online Context: Learning from the Past, Informing the Future," UCSB Research Across Disciplines, $10,000, 9/1/01-8/31/02.

- K. Almeroth, "Monitoring and Maintaining the Global Multicast Infrastructure," Cisco Systems Inc., $54,600, 7/1/01-indefinite.

- R. Kemmerer, K. Almeroth, et al., "Hi-DRA High-speed, Wide-area Network Detection, Response, and Analysis," Department of Defense (DoD), $4,283,500, 5/1/01-4/30/06.

- A. Singh, K. Almeroth, et al., "Digital Campus: Scalable Information Services on a Campus-wide Wireless Network," National Science Foundation (NSF), 1,450,000, 9/15/00-12/31/04.

- K. Almeroth, "Visualizing the Global Multicast Infrastructure," UC MICRO w/ Cisco Systems Inc., $85,438, 7/1/00-6/30/02.

- H. Lee, K. Almeroth, et al., "Dynamic Sensing Systems," International Telemetering Foundation, $260,000, 07/01/00-06/30/04.

- B. Bimber and K. Almeroth, "Funding for the Center on Information Technology and Society," $250,000 from Dialogic (an Intel Company) and $250,000 from Canadian Pacific.

- K. Almeroth, "CAREER: From Protocol Support to Applications: Elevating Multicast to a Ubiquitous Network Service," National Science Foundation (NSF), $200,000, 9/1/00-8/31/04.

- K. Almeroth, "Characterizing Multicast Use and Efficiency in the Inter-Domain," Sprint Advanced Technology Laboratories, $62,500, 3/1/00-indefinite.

- K. Almeroth, "Producing the Next Generation of Multicast Monitoring and Management Protocols and Tools," UC MICRO w/ Cisco Systems Inc., $124,500, 7/1/99 - 6/30/01.

- K. Almeroth, "Utilizing Satellite Links in the Provision of an Inter-Wide Multicast Service," HRL Laboratories, $20,000, 7/1/99 - indefinite.

- T. Smith, K. Almeroth, et al., "Alexandria Digital Earth Prototype," National Science Foundation, $5,400,000, 4/1/99-3/31/04.

- V. Vesna, K. Almeroth, et al., "Online Public Spaces: Multidisciplinary Explorations in Multi-User Environments (OPS:MEME), Phase II," UCSB Research Across Disciplines, $50,000, 9/1/98-8/31/99.

- K. Almeroth, "Techniques and Analysis for the Provision of Multicast Route Management," UC MICRO w/ Cisco Systems Inc., $97,610, 7/1/98 - 6/30/00.

- K. Almeroth, "Capturing and Modeling Multicast Group Membership in the Multicast Backbone (MBone)," UC MICRO w/ Hughes Research Labs, $19,146, 7/1/98 - 12/31/99.

- K. Almeroth, "Building a Content Server for the Next Generation Digital Classroom," UCSB Faculty Research Grant, $5,000, 7/1/98-6/31/99.

H. Research Honors and Awards

- IEEE Fellow Status, 2013
- Finalist for Best Paper Award, IEEE Conference on Sensor and Ad Hoc Communications and Networks (SECON), June 2008
- Best Paper Award, Passive and Active Measurement (PAM) Conference, April 2007
- Outstanding Paper Award, World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA), June 2006
- IEEE Senior Member Status, 2003
- Finalist for Best Student Paper Award, ACM Multimedia, December 2002
- Outstanding Paper Award, World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED MEDIA), June 2002
- Computing Research Association (CRA) Digital Government Fellowship, 2001
- National Science Foundation CAREER Award, 2000

- Best Paper Award, 7th International World Wide Web Conference, April 1998

III. Service

A. Professional Activities

1. Society Memberships

Member, Association for Computing Machinery (ACM): 1993-present
Member, ACM Special Interest Group on Communications (SIGComm): 1993-present
Fellow, Institute of Electrical and Electronics Engineers (IEEE): 1993-present
Member, IEEE Communications Society (IEEE ComSoc): 1993-present
Member, American Society for Engineering Education (ASEE): 2003-2006

2. Review Work for Technical Journals and Publishers

NSF CISE research proposals, IEEE/ACM Transactions on Networking, IEEE/ACM Transactions on Computers, IEEE/ACM Transactions on Communications, IEEE Transactions on Circuits and Systems for Video Technology, IEEE Transactions on Parallel and Distributed Systems, IEEE Transactions on Multimedia, IEEE Communications, IEEE Communications Letters, IEEE Network, IEEE Internet Computing, IEEE Multimedia, IEEE Aerospace & Electronics Systems Magazine, ACM Transactions on Internet Technology, ACM Transactions on Multimedia Computing, Communications and Applications, ACM Computing Surveys, ACM Computer Communications Review, ACM Computeres in Entertainment, ACM/Springer Multimedia Systems Journal, AACE Journal of Interactive Learning (JILR), International Journal of Computer Mathematics, Journal of Communications and Networks, Journal of Parallel and Distributed Computing, Journal of Network and Systems Management, Journal of High Speed Networking, Journal of Communications and Networks, Journal on Selected Areas in Communications, Journal of Wireless Personal Communications, Personal Mobile Communications, Annals of Telecommunications, International Journal of Wireless and Mobile Computing, Pervasive and Mobile Computing (PMC), Wireless Networks Journal, Computer Networks Journal, Cluster Computing, Computer Communications, Mobile Computing and Communications Review, Performance Evaluation, Software--Practice & Experience, Information Processing Letters, ACM Sigcomm, ACM Multimedia, ACM Network and System Support for Digital Audio and Video Workshop (NOSSDAV), ACM Sigcomm Workshop on the Economics of Peer-to-Peer Systems (P2PEcon), ACM Sigcomm Workshop on Challenged Networks (CHANTS), IEEE Infocom, IEEE Globecom, IEEE Global Internet (GI) Symposium, IEEE Globecom Automatic Internet Symposium, IEEE Globecom Internet Services and Enabling Technologies (IS&ET) Symposium, IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM), IEEE International Conference on Network Protocols (ICNP), IEEE Conference on Sensor and Ad Hoc Communications and Networks (SECON), IEEE International Conference on Multimedia and Exposition (ICME), IEEE International Conference on Communications (ICC), IEEE International Conference on Parallel and Distributed Systems (ICPADS) IEEE International Symposium on High-Performance Distributed Computing (HPDC), IEEE International Conference on Distributed Computing Systems (ICDCS), IEEE International Workshop on Quality of Service (IWQoS), IEEE/IFIP Network Operations and Management Symposium (NOMS), IFIP/IEEE International Symposium on Integrated Network Management (IM), IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS), IEEE Aerospace & Electronics Systems Magazine, SPIE Conference on Multimedia Computing and Networking (MMCN), IFIP Networking, IASTED International Conference on Information Systems and Databases

(ISD), IASTED International Conference on Communications, Internet, and Information Technology, IASTED International Conference on Internet and Multimedia Systems and Applications (IMSA), IASTED International Conference on European Internet and Multimedia Systems and Applications (EuroIMSA), IASTED International Conference on Communications and Computer Networks (CCN), IASTED International Conference on Software Engineering and Applications (SEA), International Conference on Computer and Information Science (ICIS), International Association for Development of the Information Society (IADIS) International Conference on the WWW/Internet, Workshop on Network Group Communication (NGC), International Conference on Next Generation Communication (CoNEXT), International Conference on Parallel Processing (ICPP), International Conference on Computer Communications and Networks (IC3N), International Workshop on Hot Topics in Peer-to-Peer Systems (Hot-P2P), International Workshop on Wireless Network Measurements (WiNMee), International Workshop on Incentive-Based Computing (IBC), International Workshop on Multi-hop Ad Hoc Networks (REALMAN), International Workshop on Broadband Wireless Multimedia: Algorithms, Architectures and Applications (BroadWIM), International Packet Video (PV) Workshop, High Performance Networking Conference (HPN), International Parallel Processing Symposium (IPPS), International Symposium on Innovation in Information & Communication Technology (ISIICT), Workshop on Coordinated Quality of Service in Distributed Systems (COQODS), Pearson Education (Cisco Press) Publishers, Macmillan Technical Publishing, and Prentice Hall Publishers.

3. Conference Committee Activities

Journal/Magazine Editorial Board
IEEE/ACM Transactions on Networking (ToN): 2003-2009, 2013-present
Journal of Network and Systems Management (JNSM): 2011-present
ACM Computers in Entertainment: 2002-present
IEEE Network: 1999-2012
AACE Journal of Interactive Learning Research (JILR): 2003-2012
IEEE Transactions on Mobile Computing (TMC): 2006-2011
ACM Computer Communications Review (CCR): 2006-2010

Journal/Magazine Guest Editorship

IEEE Journal on Selected Areas in Communications (JSAC) Special Issue on "Delay and Disruption Tolerant Wireless Communication", June 2008
Computer Communications Special Issue on "Monitoring and Measuring IP Networks", Summer 2005
Computer Communications Special Issue on "Integrating Multicast into the Internet", March 2001

Conference/Workshop Steering Committee
IEEE International Conference on Network Protocols (ICNP): 2007-present
ACM Sigcomm Workshop on Challenged Networks (CHANTS): 2006-present
International Workshop on Network and Operating System Support for Digital Audio and Video (NOSSDAV): 2001-present, 2005-2011 (chair), 2012-present (co-chair)
IEEE Global Internet (GI) Symposium: 2005-2013
IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS): 2005-2009

Conference/Workshop Chair

International Conference on Communication Systems and Networks (COMSNETS): 2014 (co-chair)
ACM International Conference on Next Generation Communication (CoNext): 2013 (co-chair)
ACM RecSys News Recommender Systems (NRS) Workshop and Challange: 2013 (co-chair)
ACM Sigcomm Workshop on Challenged Networks (CHANTS): 2006 (co-chair)

IEEE International Conference on Network Protocols (ICNP): 2003 (co-chair), 2006
International Workshop on Wireless Network Measurements (WiNMee): 2006 (co-chair)
IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS): 2002 (co-chair)
International Workshop on Network and Operating System Support for Digital Audio and Video (NOSSDAV): 2002 (co-chair), 2003 (co-chair)
IEEE Global Internet (GI) Symposium: 2001 (co-chair)
International Workshop on Networked Group Communication (NGC): 2000 (co-chair)

Program Chair

International Conference on Computer Communication and Networks (ICCCN): 2015 (Track co-chair)
International Conference on Communication Systems and Networks (COMSNETS): 2010
IEEE International Conference on Network Protocols (ICNP): 2008 (co-chair)
IEEE Conference on Sensor and Ad Hoc Communications and Networks (SECON): 2007 (co-chair)
IFIP Networking: 2005 (co-chair)

Posters/Demonstrations Chair

ACM Sigcomm: 2012 (co-chair)

Student Travel Grants Chair

ACM Sigcomm: 2010 (co-chair)

Publicity Chair

IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS): 2004 (co-chair)

Keynote Chair

IEEE Infocom: 2005 (co-chair)

Local Arrangements Chair

Internet2 "Field of Dreams" Workshop: 2000

Tutorial Chair

ACM Multimedia: 2000
IEEE International Conference on Network Protocols (ICNP): 1999

Panel/Session Organizer

NSF ANIR PI 2003 Panel on "Core Networking Issues and Protocols for the Internet"
CCW 2001 Session on "Multicast/Peer-to-Peer Networking"
NOSSDAV 2001 Panel on "Multimedia After a Decade of Research"
NGC 2000 Panel on "Multicast Pricing"

Technical Program Committee

IEEE International Conference on Network Protocols (ICNP): 1999, 2000, 2001, 2003, 2004, 2005, 2006, 2007, 2008, 2009 (Area Chair), 2010 (Area Chair), 2011 (Area Chair), 2012 (Area Chair), 2013, 2014 (Area Chair), 2015 (Area Chair), 2016 (Area Chair)
International Workshop on Network and Operating System Support for Digital Audio and Video

(NOSSDAV): 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016

ACM Multimedia (MM): 2001, 2003, 2004, 2005 (short paper), 2006, 2007, 2008, 2008 (short paper), 2010, 2011, 2012, 2013, 2015

IEEE Conference on Sensor and Ad Hoc Communications and Networks (SECON): 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011 (Area Chair), 2012 (Area Chair), 2013, 2014 (Area Chair), 2015, 2016 (Area Chair)

IEEE/IFIP Network Operations and Management Symposium (NOMS): 2004, 2006, 2010

IEEE Infocom: 2004, 2005, 2006, 2008, 2009, 2010 (Area Chair), 2011 (Area Chair), 2012 (Area Chair)

IFIP Networking: 2004, 2005, 2006, 2007, 2010, 2011, 2012, 2013, 2014, 2015, 2016

ACM Workshop on Mobile Video (MoVid): 2014, 2015, 2016

ACM Student Research Competition (SRC) Grand Finals: 2014

Mobile and Social Computing for Collaborative Interactions (MSC): 2014

IEEE Conference on Communications and Network Security (CNS): 2013

IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM): 2005, 2006, 2007, 2008, 2009, 2010

ACM Sigcomm Workshop on Challenged Networks (CHANTS): 2006, 2008, 2009, 2010, 2011, 2012, 2016

IEEE International Conference on Distributed Computing Systems (ICDCS): 2006, 2010, 2011, 2012, 2013

International Workshop on Wireless Network Measurements (WiNMee): 2006, 2008, 2010

ACM Sigcomm: 2008 (poster), 2010

IEEE International Conference on Computer Communication and Networks (IC3N): 2008, 2009, 2010, 2011, 2012

International Conference on Communication Systems and Networks (COMSNETS): 2009, 2010, 2011, 2012, 2013

International Conference on Sensor Networks (SENSORNETS): 2012

International Workshop on Social and Mobile Computing for Collaborative Environments (SOMOCO): 2012

Workshop on Scenarios for Network Evaluation Studies (SCENES): 2009, 2010, 2011

ACM Multimedia Systems (MMSys): 2010, 2011, 2012, 2015, 2016

IEEE International Conference on Pervasive Computing and Communications (PerCom): 2010

IEEE Wireless Communications and Networking Conference (WCNC): 2010, 2011

ACM International Symposium on Mobility Management and Wireless Access (MobiWac): 2010, 2011

International Conference on Computing, Networking and Communications, Internet Services and Applications Symposium (ICNC-ISA): 2012, 2013

IEEE WoWMoM Workshop on Hot Topics in Mesh Networking (HotMesh): 2010, 2011, 2012, 2013

IEEE Workshop on Pervasive Group Communication (PerGroup): 2010

ACM International Conference on Next Generation Communication (CoNEXT): 2005, 2006, 2007, 2009, 2012

IEEE International Conference on Broadband Communications, Networks, and Systems (BroadNets) Wireless Communications, Networks and Systems Symposium: 2007, 2008, 2009

IEEE International Conference on Broadband Communications, Networks, and Systems (BroadNets) Internet Technologies Symposium: 2007, 2008, 2009

International Workshop on Mobile and Networking Technologies for Social Applications (MONET): 2008, 2009

Extreme Workshop on Communication-The Midnight Sun Expedition (ExtremeCom): 2009

IEEE International Workshop on Cooperation in Pervasive Environments (CoPE): 2009

International Workshop on the Network of the Future (FutureNet): 2009, 2010, 2011, 2012

IEEE International Conference on Multimedia and Exposition (ICME): 2010

SPIE Conference on Multimedia Computing and Networking (MMCN): 2004, 2008

ACM Sigcomm Workshop on the Economics of Networks, Systems, and Computation (NetEcon):

2008

IEEE International Conference on Communications (ICC): 2008

IEEE International Conference on Mobile Ad-hoc and Sensor Systems (MASS): 2008

IFIP/IEEE International Symposium on Integrated Network Management (IM): 2005, 2007

Global Internet (GI) Symposium: 2001, 2002, 2004, 2006, 2007

IEEE/ACM International Conference on High Performance Computing (HiPC): 2007

ACM International Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc): 2007

IEEE Workshop on Embedded Systems for Real-Time Multimedia (ESTIMedia): 2007

IEEE/IFIP Wireless On Demand Network Systems and Services (WONS): 2007

IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS): 2001, 2002, 2003, 2004, 2005, 2006

IASTED International Conference on European Internet and Multimedia Systems and Applications (EuroIMSA): 2004, 2006

IEEE International Conference on Parallel and Distributed Systems (ICPADS): 2005, 2006

IEEE Globecom Internet Services and Enabling Technologies (IS&ET) Symposium: 2006

International Workshop on Incentive-Based Computing (IBC): 2006

IEEE International Workshop on Quality of Service (IWQoS): 2006, 2014, 2015

International Workshop on Multi-hop Ad Hoc Networks (REALMAN): 2006

IEEE Globecom Automatic Internet Symposium: 2005

ACM Sigcomm Workshop on the Economics of Peer-to-Peer Systems (P2PEcon): 2005

International Conference on Parallel Processing (ICPP): 2001, 2003, 2004

International Packet Video (PV) Workshop: 2002, 2003, 2004

IEEE International Symposium on High-Performance Distributed Computing (HPDC): 2004

ACM Sigcomm: 2004 (poster)

International Workshop on Broadband Wireless Multimedia: Algorithms, Architectures and Applications (BroadWIM): 2004

International Symposium on Innovation in Information & Communication Technology (ISIICT): 2004

Workshop on Coordinated Quality of Service in Distributed Systems (COQODS): 2004

IASTED International Conference on Networks and Communication Systems (NCS): 2004

IASTED International Conference on Communications, Internet, and Information Technology (CIIT): 2004

IASTED International Conference on Internet and Multimedia Systems and Applications (IMSA): 2003, 2004

International Workshop on Networked Group Communication (NGC): 1999, 2000, 2001, 2002, 2003

International Association for Development of the Information Society (IADIS) International Conference on the WWW/Internet: 2003

International Conference on Computer and Information Science (ICIS): 2003

Human.Society@Internet: 2003

IASTED International Conference on Communications and Computer Networks (CCN): 2002

The Content Delivery Networks (CDN) Event: 2001

IP Multicast Initiative Summit: 1998, 1999, 2000

Corporation for Education Network Initiatives in California (CENIC): 1999

Internet Bandwidth Management Summit (iBAND): 1998, 1999

B. Technical Activities

1. Working Groups

Internet2 Working Group on Multicast, Chair: 1998-2005

IEEE Communications Society Internet Technical Committee (ITC), Conference Coordinator: 2000-2004

IETF Multicast Directorate (MADDOGS), Member: 1999-2001

IASTED Technical Committee on the Web, Internet and Multimedia, Member: 2002-2005
Internet Engineering Task Force (IETF), various working groups: 1995-present

2. Meeting Support Work

Internet Engineering Task Force MBone broadcasts: 1995-2005
Conference MBone broadcasts: Sigcomm '99, and '00
Interop+Networld Network Operations Center (NOC) Team Member: 1995-1997
ACM Multimedia technical staff: 1994

C. University of California Committees

1. Department of Computer Science Committees

Public Relations: 2005-2006 (chair 2005-2006), 2009-2011 (chair 2009-2011)
Strategic Planning: 2000-2002, 2003-2006, 2009-2011
Undergraduate Advising and Affairs: 2006-2007, 2014-2015
Vice Chair: 2000-2005
Graduate Admissions: 2000-2005 (chair 2000-2005), 2011-2012
Graduate Affairs: 2000-2005 (co-chair 2000-2005)
Teaching Administration: 2000-2005
Facilities: 1997-2001 (chair 1999-2000), 2006-2007
External Relations: 1999-2002
Computer Engineering Public Relations: 2011-2012
Computer Engineering Awards: 2011-2012
Computer Engineering Administration/Recruiting: 1998-2001
Computer Engineering Lab and Computer Support: 1998-2001
Faculty Recruiting: 1999-2002
Graduate Advising: 1998-1999, 2000-2005

2. University Committees

Member, Campus Budget and Planning: 2013-2015
Faculty, Cognitive Science Program: 2006-present
Faculty, Technology Management Program (TMP): 2003-2014
Faculty, Media Arts and Technology (MAT) Program: 1998-2014
Faculty, Computer Engineering Degree Program: 1998-present
Steering Committee, Center for Information Technology and Society (CITS): 2012-present
Associate Director, Center for Information Technology and Society (CITS): 1999-2012
Member, Campus Committee on Committees: 2010-2013
Member, Campus Income and Recharge Committee: 2010-2013
Member, College of Engineering Executive Committee: 2010-2012 (chair 2011-2012), 2014-2015 (chair 2014-2015)
Member, Distinguished Teaching Award Committee: 2009, 2010, 2011
Member, Campus Classroom Design and Renovation Committee: 2003-2010
Member, ISBER Advisory Committee: 2008-2011
Member, Fulbright Campus Review Committee: 2007
Member, Faculty Outreach Grant Program Review Committee: 2007
Executive Vice Chancellor's Information Technology Fee Committee: 2005-2006

Council on Research and Instructional Resources: 2003-2006
Executive Vice Chancellor's Working Group on Graduate Diversity: 2004-2005
Member, Engineering Pavillion Planning Committee: 2003-2005
Information Technology Board: 2001-2004
Executive Committee, Center for Entrepreneurship & Engineering Management (CEEM): 2001-2004

3. System Wide Committees

UCSB Representative to the Committee on Information Technology and Telecommunications Policy (ITTP): 2003-2005
UCSB Representative to the Executive Committee, Digital Media Innovation (DiMI): 1998-2003

D. Georgia Tech Committees and Service (while a graduate student)

Graduate Student Body President: 1994-1995
Georgia Tech Executive Board: 1994-1995
Georgia Tech Alumni Association Executive Committee: 1994-1995
Dean of Students National Search Committee: 1995
Institute Strategic Planning Committee: 1994-1996

Cases in last 4 years I have been deposed or testified:

➢ Two depositions in Intermec Technologies Corp. v. Palm Inc. (07-272-SLR, D. Del.). Finished: 05/12.

➢ A deposition in iHance, Inc. v. Eloqua Corp. (2:11-CV-257-MSD-TEM, E.D. Va.). Finished: 06/12.

➢ A deposition in Apple, Inc. v. Motorola Mobility, Inc. (11-CV-178 (BBC), W.D. Wis.). Finished: 10/12.

➢ A deposition and trial testimony in Two-Way Media LLC v. AT&T Inc., et al. (SA-09-CA-476-OLG, W.D. Tex.). Finished: 03/13.

➢ Depositions in British Telecommunications PLC v. CoxCom, Inc., Cox Communications, Inc., & Cable One, Inc. (10-658-SLR, D. Del.). Finished: 01/14.

➢ A deposition and trial testimony in Certain Digital Media Devices, Including Televisions, Blu-Ray Disc Players, Home Theater Systems, Tablets and Mobile Phones, Components Thereof and Associated Software (ITC Inv. No. 337-TA-882) [Black Hills Media v. Samsung]. Finished 02/14.

➢ A deposition in Inter Partes Review of U.S. Patent No. 7,107,612 (IPR2013-00369) [Palo Alto Networks, Inc. v. Juniper Networks, Inc.]. Finished 05/14.

➢ A deposition and trial testimony in EON Corp Holdings, LCC. v. Landis+Gyr, Inc, et al. (6:11-CV-317-LED-JDL, E.D. Tex.). Finished 06/14.

➢ Depositions in Straight Path IP Group, Inc. v. Bandwidth.com, Inc., Telesphere Networks Ltd., and Vocalocity, Inc. (1:13-CV-932, E.D. Va.). Finished 06/14.

➢ Depositions and trial testimony in Beneficial Innovations, Inc. v. Advanced Publications, Inc. et al. (2:11-CV-229-JRG-RSP, E.D. Tex.). Finished 07/14.

➢ Depositions in Robocast Inc. v. Apple Inc. (11-235-RGA, D. Del.) and Robocast Inc. v. Microsoft Corp. (10-1055-RGA, D. Del.). Finished 08/14.

➢ A deposition in PersonalWeb Technologies, LCC v. Yahoo! Inc. (6:12-CV-658-LED, E.D. Tex.). Finished 08/14.

➢ Depositions and trial testimony in Personal Audio LLC v. Togi Entertainment, Inc. et al. (2:13-CV-13-JRG-RSP, E.D. Tex.). Finished 09/14.

➢ A deposition in Inter Partes Review of U.S. Patent Nos. 8,326,924 and 8.239,451 (CBM2014-00001 and CBM2014-00050, respectively) [American Express Co. et al. v. Metasearch Systems, LLC]. Finished 09/14.

➢ Depositions in Inter Partes Review of U.S. Patent Nos. 6,044,062 (IPR2013-00482) and 6,249,516 (IPR2014-00147) [ABB Technology LTD v. IPCO, LLC]. Finished 10/14.

➢ A deposition in Inter Partes Review of U.S. Patent No. 5,995,091 (IPR2014-00153 and IPR2014-00154) [Adobe Systems Inc & Level3 Communications, LLC v. Afluo, LLC]. Finished 10/14.

➢ Depositions in Inter Partes Review of U.S. Patent Nos 8,145,268; 8,224,381; 8,135,398; 7,899,492; 8,050,711; and 8,712,471 (IPR2013-00569, IPR2013-00570, IPR2013-00571, IPR2013-00572, IPR2013-00573 and IPR2015-00054, respectively) [Samsung Electronics Co., LTD v. Virginia Innovation Sciences, Inc.]. Finished 11/14.

➢ A deposition in Black Hills Media, LLC v. Sonos, Inc. (14-cv-00486-SJC-PJWx, C.D. Cal.). Finished 02/15.

➢ Markman testimony in Personal Audio, LLC v. Apollo Brands et al. (1:14-CV-8-RC, E.D. Tex.). Finished 06/15.

➢ Depositions in Inter Partes Review of U.S. Patent Nos. 8,028,323; 8,230,099; 8,214,873; 6,108,686; 7,835,689; and 7,917,082 (IPR2014-00709, IPR2014-00711, IPR2014-00723, IPR2014-00717, IPR2014-00718, and IPR2014-00721, respectively) [Samsung Electronics Co., LTD v. Black Hills Media, LLC]. Finished 06/15.

➢ A deposition in Inter Partes Review of U.S. Patent No. 7,548,875 (IPR2014-01236) [MindGeek et al. v. Skky, Inc.]. Finished 06/15.

➢ A deposition in Inter Partes Review of U.S. Patent Nos. 7,468,661 (IPR2014-00751) [Hart Communication Foundation v. SIPCO, LLC]. Finished 07/15.

➢ Depositions in Inter Partes Review of U.S. Patent No. 6,754,195 (IPR2014-00552 and IPR2014-00553) [Marvell Semiconductor, Inc. v. Intellectual Ventures I LLC]. Finished 07/15.

➢ A deposition and trial testimony in Certain Network Devices, Related Software and Components Thereof (US ITC Inv. No. 337-TA-944) [Cisco v. Arista]. Finished 09/15.

➢ Depositions and trial testimony in Certain Network Devices, Related Software and Components Thereof (II) (US ITC Inv. No. 337-TA-945) [Cisco v. Arista]. Finished 12/15.

➢ A deposition in Inter Partes Review of U.S. Patent Nos. 6,286,045 (IPR2015-00657 and IPR2015-00660) and 6,014,698 (IPR2015-00662 and IPR2015-00666) [Google, Inc. v. At Home Bondholders Liquidated Trust]. Finished 12/15.

➢ A deposition in Sprint Communications Company LP v. Time Warner Cable, Inc. (11-2686-JWL, D. Kan.);

➢ A deposition in Cisco Systems, Inc. v. Arista Networks, Inc. (5:14-cv-5344-BLF, N.D. Cal.);

➢ A deposition in Certain Activity Tracking Devices, Systems, and Components Thereof (US ITC Inv. No. 337-TA-963) [Jawbone v. Fitbit].

➢ A deposition in Thomas C. Sisoian v. International Business Machines Corporation (A-14-CA-565-SS, W.D. Tex.)

➢ A deposition in Inter Partes Review of U.S. Patent Nos. 6,199,076 (IPR2015-00845) and 7,509,178 (IPR2015-00846) [Google, Inc. v. Personal Audio, LLC].

Cases in last 5 years I have been deposed or testified (I represented the underlined party):

➢ Two depositions in <u>Beneficial Innovations, Inc</u>. v. Blockdot, Inc. et al. (2:07-CV-263(TJW/CE) and 2:07-CV-555 (TJW/CE), E.D. Tex.). Finished: 10/10.

➢ Two depositions and trial testimony in <u>Personal Audio, LLC</u> v. Apple, Inc. (9:09-CV-00111-RC, E.D. Tex.). Finished: 07/11.

➢ Two depositions in <u>Paltalk Holdings, Inc</u>. v. Sony et al. (2:09-cv-274-DF-CE, E.D. Tex.). Finished: 09/11.

➢ A deposition and trial testimony in Certain Wireless Communication Devices, Portable Music and Data Processing Devices, Computers and Components (US ITC Inv. No. 337-TA-745) [<u>Motorola Mobility</u> v. Apple]. Finished: 04/12.

➢ Two depositions in Intermec Technologies Corp. v. <u>Palm Inc</u>. (07-272-SLR, D. Del.). Finished: 05/12.

➢ A deposition in iHance, Inc. v. <u>Eloqua Corp</u>. (2:11-CV-257-MSD-TEM, E.D. Va.). Finished: 06/12.

➢ A deposition in Apple, Inc. v. <u>Motorola Mobility, Inc.</u> (11-CV-178 (BBC), W.D. Wis.). Finished: 10/12.

➢ A deposition and trial testimony in <u>Two-Way Media LLC</u> v. AT&T Inc., et al. (SA-09-CA-476-OLG, W.D. Tex.). Finished: 03/13.

➢ Depositions in <u>British Telecommunications PLC</u> v. CoxCom, Inc., Cox Communications, Inc., & Cable One, Inc. (10-658-SLR, D. Del.). Finished: 01/14.

➢ A deposition and trial testimony in Certain Digital Media Devices, Including Televisions, Blu-Ray Disc Players, Home Theater Systems, Tablets and Mobile Phones, Components Thereof and Associated Software (ITC Inv. No. 337-TA-882) [Black Hills Media v. <u>Samsung</u>]. Finished 02/14.

➢ A deposition in Inter Partes Review of U.S. Patent No. 7,107,612 (IPR2013-00369) [Palo Alto Networks, Inc. v. <u>Juniper Networks, Inc.</u>]. Finished 05/14.

➢ A deposition and trial testimony in EON Corp Holdings, LCC. v. <u>Landis+Gyr, Inc, et al.</u> (6:11-CV-317-LED-JDL, E.D. Tex.). Finished 06/14.

➢ Depositions in <u>Straight Path IP Group, Inc.</u> v. Bandwidth.com, Inc., Telesphere Networks Ltd., and Vocalocity, Inc. (1:13-CV-932, E.D. Va.). Finished 06/14.

➢ Depositions and trial testimony in <u>Beneficial Innovations, Inc.</u> v. Advanced Publications, Inc. et al. (2:11-CV-229-JRG-RSP, E.D. Tex.). Finished 07/14.

➢ Depositions in <u>Robocast Inc.</u> v. Apple Inc. (11-235-RGA, D. Del.) and <u>Robocast Inc</u>. v. Microsoft Corp. (10-1055-RGA, D. Del.). Finished 08/14.

➢ A deposition in <u>PersonalWeb Technologies, LCC</u> v. Yahoo! Inc. (6:12-CV-658-LED, E.D. Tex.). Finished 08/14.

➢ Depositions and trial testimony in <u>Personal Audio LLC</u> v. Togi Entertainment, Inc. et al. (2:13-CV-13-JRG-RSP, E.D. Tex.). Finished 09/14.

➢ A deposition in Inter Partes Review of U.S. Patent Nos. 8,326,924 and 8.239,451 (CBM2014-00001 and CBM2014-00050, respectively) [American Express Co. et al. v. <u>Metasearch Systems, LLC</u>]. Finished 09/14.

➢ Depositions in Inter Partes Review of U.S. Patent Nos. 6,044,062 (IPR2013-00482) and 6,249,516 (IPR2014-00147) [ABB Technology LTD v. <u>IPCO, LLC</u>]. Finished 10/14.

➢ A deposition in Inter Partes Review of U.S. Patent No. 5,995,091 (IPR2014-00153 and IPR2014-00154) [Adobe Systems Inc & Level3 Communications, LLC v. Afluo, LLC]. Finished 10/14.

➢ A deposition in Black Hills Media, LLC v. Sonos, Inc. (14-cv-00486-SJC-PJWx, C.D. Cal.). Finished 02/15.

➢ Depositions in Inter Partes Review of U.S. Patent Nos 8,145,268; 8,224,381; and 8,135,398, (IPR2013-00569, IPR2013-00570, and IPR2013-00571, respectively) [Samsung Electronics Co., LTD v. Virginia Innovation Sciences, Inc.];

➢ Depositions in Inter Partes Review of U.S. Patent Nos. 8,028,323; 8,230,099; 8,214,873; 6,108,686; 7,835,689; and 7,917,082 (IPR2014-00709, IPR2014-00711, IPR2014-00723, IPR2014-00717, IPR2014-00718, and IPR2014-00721, respectively) [Samsung Electronics Co., LTD v. Black Hills Media, LLC];

➢ Depositions in Inter Partes Review of U.S. Patent No. 6,754,195 (IPR2014-00552 and IPR2014-00553) [Marvell Semiconductor, Inc. v. Intellectual Ventures I LLC];

➢ Markman testimony in Personal Audio, LLC v. Apollo Brands et al. (1:14-CV-8-RC, E.D. Tex.);

➢ A deposition in Inter Partes Review of U.S. Patent Nos. 7,468,661 (IPR2014-00751) [Hart Communication Foundation v. SIPCO, LLC]

➢ A deposition in Inter Partes Review of U.S. Patent No. 7,548,875 (IPR2014-01236) [MindGeek et al. v. Skky, Inc.];

➢ A deposition in Sprint Communications Company LP v. Time Warner Cable, Inc. (11-2686-JWL, D. Kan.);

➢ A deposition in Certain Network Devices, Related Software and Components Thereof (US ITC Inv. No. 337-TA-944) [Cisco v. Arista];

Cases With Reports/Declarations But No On-The-Record Testimony:

➢ Innovative Communications Technologies, Inc. v. Stalker Software, Inc. (2:12-CV-9-RGD-TEM, E.D. Va.). Finished: 11/12.

➢ Innovative Communications Technologies, Inc. v. ooVoo, LLC (2:12-CV-8-RGD-DEM, E.D. Va.). Finished: 11/12.

➢ Innovative Communications Technologies, Inc. v. Vivox, Inc. (2:12-CV-7-RGD-FBS, E.D. Va.). Finished: 11/12.

➢ SIPCO, LLC v. ABB, Inc. (6:11-cv-0048-LED-JDL). Finished: 12/12.

➢ Virginia Innovation Sciences, Inc. v. Samsung Electronics Co. LTD, Samsung Electronics America, Inc. and Samsung Telecommunications America LLC (2:12-cv-548-MSD-DEM, E.D. Va.). Finished: 04/14.

➢ PersonalWeb Technologies, LCC v. Google Inc. and YouTube, LLC (5:13-cv-01317 EJD, E.D. Tex.).

➢ Intellectual Ventures v. AT&T, CenturyLink, and Windstream (1:13-cv-00116-LY, 1:13-cv-00118-LY, 1:13-cv-00119-LY; W.D. Tex.)

➢ A declaration in Parallel Networks, LLC v. A10 Networks, Inc. (13-1943-LPS, D. Del.)

➢ A declaration in <u>Affinity Labs of Texas, LLC</u> v. Amazon.com Inc (6:15-cv-00029-WSS-JCM, W.D. Tex.)

➢ A declaration in Catharon Intellectual Property, LLC v. <u>FedEx Corporate Services, Inc.</u> (6:14-cv-00061-KNM, E.D. Tex.)

Cases Where I Have Been Disclosed (but no work product)

➢ Toddlerwatch.com v. <u>Motorola</u> (01-12187-REK, D. Mass.). Finished: 02/03.

➢ <u>Personal Audio, LLC</u> v. Samsung Electronics Co. Ltd. et al. (1:11-CV-432-RC, E.D. Tex.). Finished: 12/12.

➢ <u>Enterasys Networks, Inc</u>. v. Foundry Networks, LLC and Extreme Networks, Inc. (05-11298 (DPW), E.D. Mass.). Finished: 04/13.

➢ Mosaid Technologies, Inc. v. <u>Dell, Inc. et al.</u> (2:11-cv-00179-MHS-CMC, E.D. Tex.). Finished 08/13.

➢ Radware, Ltd. v. <u>A10 Networks, Inc.</u> (5:13-cv-02021-RMW, N.D. Cal.). Finished: 08/14

➢ <u>Rockstar Consortium</u> v. Google Inc. (13-cv-00893-JRG-RSP, E.D. Tex.). Finished 11/14.

➢ Intellectual Ventures I LLC and Intellectual Ventures II LLC v. <u>AT&T Mobility LLC</u>, et al. (1:12-cv-00193-LPS, D. Del.)

➢ OpenTV, Inc. et al. v. Apple, Inc. (14-cv-01622-JST, N.D. Cal.)

➢ Intellectual Ventures I LLC and Intellectual Ventures II LLC v. <u>Symantec Corp.</u> (13-440-(LPS), D. Del.)

➢ Certain Network Devices, Related Software and Components Thereof (II) (US ITC Inv. No. 337-TA-945) [<u>Cisco</u> v. Arista];